HYDRAIN - INTEGRATED DRAINAGE DESIGN COMPUTER SYSTEM

VOLUME I. HYDRAIN System

for:

Office of Technology Applications
Federal Highway Administration
Washington, DC

March 1999

(Metric Page)

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INTRODUCTION

This document reviews the capabilities of version 6.1 of the HYDRAIN application programs. These application programs perform a support function with respect to engineering programs. The documentation provides technical and operational information, and discusses user instructions. The HYDRAIN system integrates the application programs with existing and newly developed drainage programs to provide a modular, expandable, and comprehensive set of tools for the practicing engineer. The system objective is providing these tools to engineers in a form that will **enhance their productivity**.

The HYDRAIN application programs include the main HYDRAIN program and associated programs, such as editors and configuration software. The main HYDRAIN application program (HYDRAIN program) integrates and controls the entire system of Pooled Fund Project software. The HYDRAIN program supports engineering design and analysis programs and facilitates communication (data transfer) within the system. It provides a means of file and disk management. It contains tutorial capabilities and modules. The HYDRAIN program can review input, output, or other text files.

Each of the application programs are written in the C language. The language offers ease of portability, and is efficient for performing input/output operations. The C language enables software to more easily control other programs and hardware.

Definitions of the following terms are useful:

- **HYDRAIN System** - A software package of hydraulic and hydrologic analysis programs developed under the aegis of the Pooled Fund Project.

- **Engineering Program** - A program or module in the HYDRAIN system that performs hydraulic or hydrologic computations.

- **Applications Program** - A program *wrapped around* another program to facilitate its use.

- **Input Program** - An application program built around one of the engineering programs.

- **HYDRAIN Program** - The main application program built around the *entire system* of engineering and application programs.

- **HYDRAIN Editor (HYEDT)** - A special input program that provides full screen text editing capability to command line engineering programs. HYEDT supplies an intermediate to high level of support (context-sensitive one line and extended

helps and word processing abilities) for creating or editing an input data set. Appendix A presents a description of the editor.

·　　　**Interactive Programs** - This category of application program provides full screen, expert assistance in data creation/modification, range and error checks, and short and long help.

·　　　**Program Module** - A combination of input and engineering programs.

·　　　**Command Line Inputs** - A line by line method of input that keys on a command as the first item in each line. The command identifies the remaining items on the line and their organization.

The engineering programs, input programs and other modules controlled by the HYDRAIN program are:

·	HYDRA	- Storm Drain and Sanitary Sewer Design and Analysis.
·	WSPRO	- Open Channel Water Surface Analysis.
·	HYDRO	- Design Event versus Return Period.
·	HY8	- FHWA Culvert Analysis and Design.
·	HYCHL	- Flexible & Rigid Channel Lining Design and Analysis.
·	HYEQT	- Flow Equation Program.
·	NFF	- USGS National Flood Frequency Program.
·	HYEDT	- Inputs / Edits HYDRAIN command line data sets.
·	Support System Modules.	

-　　　DOS Shell (go back and forth to DOS without leaving HYDRAIN).
-　　　System Maintenance (File Housekeeping).
-　　　System Utilities (Change drives, directories, devices, colors).
-　　　System Information.

·　　Future HYDRAIN Programs - other programs included as desired by the HYDRAIN user community.

Current operational software includes HYDRA, WSPRO, HYDRO, HY8, HYCHL, NFF, and HYEQT engineering programs, HYEDT, and support system modules. Figure 1 illustrates the logical layout of these program modules.

HYDRAIN Shell

File   Editor   Analysis   Utilities   Help

Copy
Rename
Erase
View
Print
Shell
DOS
Exit

HYEDT Editor
"Command Line"
with Help.
Input or Edit
or Run/Review

Run/Review

View Directory
Change Directory
Change Drive
Change Paths
Screen Colors
Device Ports
Change Units

General
Main Menu
Keyboard
File Names
References

Run/Review/Print

Input/Edit

HYDRA
WSPRO
HY8
HYDRO
HYCHL
NFF
HYEQT

Input and Output Files in Directories
Keyed to Application Programs.

Figure 1. HYDRAIN layout.

The HYDRAIN program controls access to these modules by employing one of five primary options: **File**, **Editor**, **Analyze**, **Utilities**, and **Help**. Two options, **Editor** and **Analyze**, provide access to a corresponding engineering program by parallel branching to the design and analysis modules. The HYDRAIN program assists the user by ensuring that proper naming conventions are used and by providing on-line help upon request.

The **File** option performs many file management functions. These include the DOS equivalent activities of copying, deleting, renaming, printing or viewing files. It allows the user, through the **DOS Shell** option, to temporarily return to the DOS operating system. Finally, it allows the user to Exit the program.

Utilities allows changing and reviewing directories; switching the disk drives; and updating screen colors, default drives and directories, or device characteristics.

The **Help** option provides on-line documentation (a feature provided throughout the HYDRAIN system) for further explanation of a requested option as well as providing "how to" information and selected references.

TECHNICAL REFERENCE

SUMMARY OF FEATURES

The HYDRAIN program runs on DOS version 3.0 (or higher) on IBM-XT/PC or compatible microcomputers. It has the following capabilities:

- **Linkages to HYDRAIN Engineering Modules** - There are seven engineering programs: HYDRA, WSPRO, HYDRO, HY8, HYCHL, NFF, and HYEQT. Five of the seven are batch programs that can use the HYDRAIN editor to assist in entering/editing data. HY8 also has an internal routine that allow for the interactive input, editing, or execution of data. Likewise, HYCHL and WSPRO have interactive programs that assist in the creation, execution, and review of data.

- **Open Architecture** - This allows the number of modules and programs included in the system to grow as the user community wishes. By planning for the addition of future programs, the HYDRAIN program ensures flexibility, allowing such modules to be easily "plugged in."   The NFF program, a recent addition to HYDRAIN is such an example of open architecture.

- **Active Short Help Messages** - The HYDRAIN program (as well as other application programs) has an active, one line, context sensitive, help message that appears automatically when the cursor is on each appropriate field. The help message provides the user with a short concise description of the operation of the field. When the cursor is moved to another field, the short help message is updated.

- **Long Help on Request** - Long help messages are available to the user at any time within the HYDRAIN system by pressing function key one (denoted as **<F1>** in the documentation). These messages range in length from a short paragraph to several pages.

- **DOS Shell** - This allows the user to temporarily leave the HYDRAIN program and enter DOS. Typing **EXIT** at the DOS prompt returns the user to the HYDRAIN main menu. An obvious use of this feature is to leave the HYDRAIN program to enter a word processor or text editor, or to execute a spreadsheet program. When selecting this option, HYDRAIN will remain resident in memory. For this reason it is important to always return to the HYDRAIN program (by typing **EXIT**) and leave HYDRAIN in a normal manner (through the **Exit** suboption under the **File** option).

·   **Screen Capture of Inputs** - The primary advantage of an input program is its ability to use the entire terminal screen as an input device.

·   **File Review Module** - A file review option (in the Utilities pulldown menu) permits viewing of input, output, and other files found on the current directory. The review option uses the , , PgUp, PgDn, Home, and End keys to move vertically through a file. The option uses the   and   cursor keys to move horizontally in a file. This horizontal scrolling ability is useful for viewing documents wider than the computer's display screen; for example, a 132-character wide output file.

·   **System Maintenance** - One system support module consists of system upkeep capabilities. This system maintenance module provides the user with the DOS equivalent commands of Renaming, Copying, Deleting, and Printing files. The user can either enter a filename, or choose from files contained in the HYDRAIN directories. Additionally, the Drive and Directory features can scan the files on any drive and directory.

·   **Ring Menus** - The decision screens in the application programs consist of a series of fields linked by a ring menu. This means the user can select the option they wish to investigate by using the cursor keys to move to the field and striking carriage return or enter (denoted as <Enter> in the documentation). In most areas of the system, the user can also choose an option by simply pressing a letter which is **h**ighlighted in the field.

·   **Pulldown Menus -** These special ring menus present suboptions within the main menu options. Move any direction within pulldown menus by using the arrow keys. The advantage of pulldown menus as compared to clearing the screen to display options is that the user is able to see all of the selections they have made to get to the submenu they are in. That is, the user is able to follow a progression from entering the system to the most detailed submenu.

·   **Popup Menus -** These ring menus present additional options, choices or information. Usually the up and down arrows keys to move within these menu types. Press <Esc> to move back to the previous menu level.

FILE MANAGEMENT STRUCTURE

The overall file management structure operates on a hard-disk drive. It is possible to create a multitude of file management structures on a system. (Appendix B discusses of the custom directory layout.) Normally, HYDRAIN uses the default hard disk file structure shown in figure 2. The main directory is **HYDRAIN**. This directory contains executable and help files used by the HYDRAIN program and HYEDT. The HYDRAIN directory has a subdirectory **ITM**, that contain files shared by engineering programs. Five level one directories, designated **HYDRA**, **WSPRO**, **HYDRO**, **HY8**, and **HYCHL**, contain all executable files, input files, output files, and help files used by each particular engineering program. (As a default, HYEQT files are placed on the **HYDRO** directory and NFF files are placed on the ITM directory.) The file management structure is transparent when running the HYDRAIN package.

```
ROOT          )),
              /) HYDRAIN )))) ITM  (Intermediate/Shared Files/NFF)
              /) HYDRA  (Storm Drains)
              /) WSPRO  (Bridge Waterways)
              /) HYDRO  (Hydrology)(Also HYEQT)
              /) HY8    (Culvert Analysis, Energy Dissipators)
              /) HYCHL  (Channel Stability and Design)
              *
              .) ETC... (other directories on the drive ...)
```

Figure 2. Default HYDRAIN directory structure.

Whether or not using the default or an alternative directory structure, the HYDRAIN program uses this structure when it passes information to an input program, engineering program, or applications program. For example, when the HYDRAIN program executes HYDRA, it takes the user-supplied filename, appends the appropriate drives and paths, and passes this information to the HYDRA program. Exactly how this is accomplished for a specific program depends on whether the program called by the HYDRAIN program performs input, output, or analysis functions.

FILE NAMING CONVENTIONS

The HYDRAIN system uses standardized input and output file extensions to further ensure compatibility and to prevent the passing of incorrect files. All HYDRAIN files must follow the convention **xxxxxxxx.zzz**. The file name node or prefix (i.e., xxxxxxxx) may have up to eight characters (conforming to DOS file naming conventions). The files also require an extension (i.e.,: zzz) of up to three characters.

<u>Engineering Program Extensions</u>

To assist application programs in distinguishing the input found from different engineering programs, HYDRAIN uses some default extensions. **At the users discretion, any extension can be used instead of these defaults. The result will be that some of the helpful file finding utilities used by HYDRAIN will not function.**

·   HYDRA - the storm drain and sanitary sewer analysis and design program uses an **HDA** extension for input data and executing the program.

·   WSPRO - the bridge waterways (and open channel) analysis program uses a **WSP** extension for input data and executing the program.

·   HYDRO - the hydrology program uses an **HDO** extension for input data and executing the program.

·   HYCHL - the channel lining stability program uses a **CHL** extension for input data and executing the program.

·   HY8 - the culvert analysis and design program uses a variety of extensions to support HY8's modular computations. The culvert analysis modules uses an **INP** extension for most input data.

<u>Output File Extensions</u>

·   All output files will retain the input file name prefix (i.e. **xxxxxxxx**), but they will have **LST** extensions (HY8 output files have **PC** extensions).

<u>Other File Extensions</u>

·   **QT** -   This extension contains the ordinates of a hydrograph (i.e.: flow, **Q**, versus time, **T**). HYDRO, HY8, NFF, and HYCLV generate this type of file. Hydrograph files can be incorporated as input data in other engineering programs (for example, into HYCLV using the **HYD** command).

·   **HYE** -   This extension contains the ordinates of a hyetograph (i.e.: rainfall intensity, **I**, versus time, **T**). HYDRO generates the file, which, at user option, can be incorporated into the other engineering programs.

·   **IDF** -   This extension contains the ordinates of an Intensity-Duration-Frequency (IDF) curve (for a duration from 5 min to 24 h). HYDRO generates the file, which, at user option, can be incorporated into HYDRA or HYCLV using the **RAI** command.

·   **Q** - This extension contains design flow values generated by a HYDRO analysis. In the future, other programs will read these values as input data.

· **HLP** - This extension indicates the file contains short and long help for the different application programs. There will be at least two help files for each engineering program.

· **CNF** - This extension indicates the file contains information used by the HYDRAIN system. **HYDRAIN.CNF** is the primary file using this extension. Appendix B contains more information on this file. This extension also indicates a file containing information used by the HY8 program. The HY8 information may consist of configuration, print, and setup data.

· **DAT -** This extension indicates that the file contains HY8 culvert information pertaining to industry's available sizes for different pipe culverts.

· **ERR** - This extension contains any system error messages. The HYDRAIN and editor programs capture the standard error output (if any) to assist in debugging.

The file conventions, when combined with the file management structure discussed earlier, provides a method of organizing HYDRAIN files within the DOS environment. HYDRAIN expects designated directories to contain specific files. This avoids the confusing proliferation of many different input files within a single DOS directory. For example, if using the default directory structure, HYDRO input files will be found in the **HYDRO** input subdirectory, WSPRO executable files will be found in the **WSPRO** executable subdirectory, and so forth. HYDRAIN placed files used by differing programs (such as files with **IDF**, **QT**, and **HYE** extensions) in a common subdirectory, **ITM**, where they too can be readily accessed by engineering modules.

KEYBOARD USAGE

HYDRAIN reserves certain keys to assist the user in performing specific tasks. Generally, the meaning of each of the keys is the same. Some program specific variations occur, but usually within the context of that program. In any event, the appropriate documentation provides the specific meaning. This document normally indicates use of a key by enclosing it within the < and > characters. For example, <Enter> means "press the Enter key."

<u>Cursor Keys</u>

The cursor keys permit movement through the screens and windows found in the application programs. The active cursor keys are:

	-	Moves the cursor to the left one field or space.
	-	Moves the cursor to the right one field or space.
	-	Moves the cursor up one line.
	-	Moves the cursor down one line.
PgDn	-	Moves screen display forward one page.
PgUp	-	Moves screen display backwards one page.
Home	-	Moves to beginning of a field.
End	-	Moves to end of a field.
Crtl+Home	-	Moves to top of document displayed.
Crtl+End	-	Moves to bottom of document displayed.
Ins	-	Toggles between insert and replace modes.
Del	-	Deletes character at cursor location.
Backspace	-	Moves cursor left, deleting the character.

<u>Function Keys</u>

HYDRAIN uses function keys in different ways, depending on the application program. One primary function key (F1) is active throughout every application program. Secondary function keys are available in various regions of the system. **The current screen typically displays the function key(s) currently active in the module or program.)** Various function keys active in the HYDRAIN program are:

F1   -   Long (Extended) Help. This primary function key produces a window of long, context-sensitive help. This is always active in all application programs.

F3   -   Secondary function key used in the file erase section of the HYDRAIN program (one of the File suboptions).

<u>Other Keys</u>

| Enter | - | Enter/Carriage Return - continue to the next screen. |
| Esc | - | Aborts an operation (escapes). |

MINIMUM EQUIPMENT CONFIGURATION

The HYDRAIN system uses a minimum equipment configuration (MEC) to provide a fundamental, uniform hardware and software platform. The HYDRAIN system is upgradable; it will normally run on equipment that exceeds the MEC. A common problem is not enough memory to execute the programs. Try to maximize the available memory before starting the HYDRAIN system. (A suggested minimum quantity of memory is approximately 560 kB of RAM.)

Hardware

- · IBM XT/PC (or 100 percent compatible) with 640 kB RAM.
- · 360-kB (5¼-in) floppy diskette drive or 1.4-MB (3½-in) floppy diskette drive.
- · Hard disk drive with a minimum storage capacity of 10 MB suggested. A minimum of 6.8 MB required for installation.
- · Math coprocessor (8087, 80287, 80387) recommended.
- · Monochrome monitor and adapter (24×80); VGA card and monitor recommended.
- · Dot matrix printer.
- · Surge/spike protector.

Graphical capabilities of the HY8, HYCHL, and WSPRO programs require a graphics card having, at least, Color Graphics Adapter (CGA) abilities. These programs can also run without a CGA card. Because of future HYDRAIN enhancements, a VGA card is recommended for all equipment.

Software

- · DOS (version 3.0 or higher).

BASIC, FORTRAN, and C compilers are not required to run the HYDRAIN programs as supplied, but are the compilers used for HYDRAIN.

USER DOCUMENTATION

This section discusses how to install the HYDRAIN system and execute the HYDRAIN program. The installation assumes that there is a 3½- or 5¼-in floppy disk drive on the computer. Furthermore, it assumes that the computer designates the disk device as drive A.[1] The required hard disk drive should contain at least 6.8 MB of free storage space. The discussion on executing the HYDRAIN program provides an overview on the features present in the software. Experience serves to enhance proficiency.

INSTALLATION

The following is a description of the procedure to be performed in order to successfully install the HYDRAIN system onto a microcomputer. The Install program itself is quite descriptive and the user is prompted for all necessary information. The user will notice that, at the bottom right corner of virtually every screen, the message "To continue, press any key" is displayed. This ensures that the user has sufficient time to read all of the information presented on the screen.

Begin by placing the Install diskette (this is always diskette one) into the A drive. Change to the A drive. Type **INSTALL** and press <Enter> to begin the program.[2,3]

The first screen displayed provides the user with information about the system: the DOS version detected, the presence of a math coprocessor, and the graphics card detected. In the case that the DOS version is less than 3.0, the Install program will automatically terminate. It is recommended that a math coprocessor be purchased and installed on the machine. The install program displays a prompt "To continue, press any key" that moves the program to the next screen. (Should the user need to leave the installation program, they can strike <Esc> when prompted by the program.)

If this is an initial installation of HYDRAIN, the next screen asks the user to choose the disk drive from which HYDRAIN will be run. The HYDRAIN system requires 6.8 MB of disk space, therefore, it is important to choose a drive with sufficient free space. To aid the user in

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[1]HYDRAIN will install from either drive A or B. For the sake of clarity, the documentation assumes that the installation occurs on drive A. The installation diskette includes a README.1ST file to aid the user.

[2]To install on a gas plasma display computer, type **INSTALL P** and press <Enter>. The installation program will change internal defaults to display text in black and white.

[3]If a CD-ROM drive is installed on the system, ensure a disk is present in the drive.

making a selection, the screen displays the amount of free space available on all of the hard disks. If a drive is selected which has insufficient space, the program will terminate and offer the user the opportunity to clear space on the disk. If a feasible drive is selected, the next screen will either show the program creating the new directories or begin copying the files.

If the system detects an older version of HYDRAIN, it will then inform the user that HYDRAIN exists. Choosing "Stop" will allow the user to leave the Install program to back-up or remove the old files. Choosing "Continue" will result in a screen which gives explanations as to what (if any) new directories have been created.

Next, the user is asked whether Metric or English units are to be used as default units. To change default units requires reinstallation; however, the user may switch between units systems at will from within the HYDRAIN shell.

The program will then load the information from the first diskette onto the selected drive. The block in the center of the screen tells the user exactly what procedure is being carried out. To conserve space, most of the files have been compressed. Later in the installation procedure, these files will be unpacked.

After all of the information from diskette 1 is copied, the following prompt is displayed:

Insert Disk 2 of 2 into disk drive

After the second distribution disk is properly inserted, the program will then copy all of the information from diskette 2 to the appropriate directories.

After the files have been copied to their respective directories, the installation program creates three files, **HYDRAIN.CNF**, **PRINT.CNF**, and **HY8.CNF**. These files contain information developed by the installation program. This file creation process is transparent to the user. If the **HYDRAIN.CNF** and **HY8.CNF** files are already present on the system, they will be modified to reflect changes in HYDRAIN. In this manner, previous settings will not be lost.

Upon completion of this file creation, the compressed files will be unpacked. Older versions of the programs and files, if they exist, will be overwritten. HYDRAIN is now installed on the computer. After deleting some older and unused files, the installation program will terminate, leaving the user in the HYDRAIN main directory.

The user should add the HYDRAIN and HY8 directories to the PATH statement in their AUTOEXEC.BAT file. After this is done, the HYDRAIN system is ready to be used.

USING THE HYDRAIN PROGRAM

To enter the HYDRAIN system, change the directory and type **HYDRAIN** as follows:

C> CD HYDRAIN   and press <Enter>
C> HYDRAIN   and press <Enter>

The first HYDRAIN program screen, depicted below in figure 3, will appear on the monitor.[4] This screen provides introductory program information. At the top of the screen is the program title and current version (the version number is important for assisting in user support questions). These are followed by a listing of the 31 sponsoring States in the Pooled Fund. Press any key to continue.

```
                  HYDRAIN - DRAINAGE DESIGN SYSTEM
                           Version 6.1

  Sponsored by the Pooled Fund Project States:

      Alabama        Arizona       Arkansas     California    Colorado
      Connecticut    Florida       Idaho        Illinois      Iowa
      Kansas         Louisiana     Maryland     Minnesota     Mississippi
      Montana        Nebraska      New Jersey   New York      N Carolina
      N Dakota       Oklahoma      Oregon       Pennsylvania  S Carolina
      Texas          Utah          Vermont      Virginia      Washington
      Wyoming
                in cooperation with the Federal Highway Administration




                              developed by:
                GKY & Associates, Inc., Springfield, VA.



                                       To continue, press any key.
```

Figure 3. Initial screen for HYDRAIN program.

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[4]This first screen will always appear unless using an **S** argument when running the program (i.e., **HYDRAIN S**). This is a feature for those who might call HYDRAIN from a menu or shell.

The second screen contains a statement dealing with the responsibilities of the user and the FHWA. Again, any key can be pressed to continue.

Main Menu

The next screen is the HYDRAIN **Main Menu**, illustrated in figure 4. The Main Menu is the principle decision node for the entire HYDRAIN system. This means that to reach any module in the HYDRAIN system, the user must begin with this menu. The **Main Menu**, as well as several other menus in the HYDRAIN program, is a ring menu. Ring menus enable the user to move in either the left or right directions using the arrow keys. The *ring* means that moving the cursor right of the **Help** option moves it back to the **File** option. Similarly, moving left of **File** places the cursor back at **Help**.

```
 HYDRAIN    Version 6.1    METRIC
 Thursday May 1, 1997  6:01:00 am          F1-Help | C:\HYDRAIN
     File          Editor     Analyze    Utilities              Help

                  HYDRA
                  WSPRO
                  HYDRO
                  HYCHL
                   HY8
```
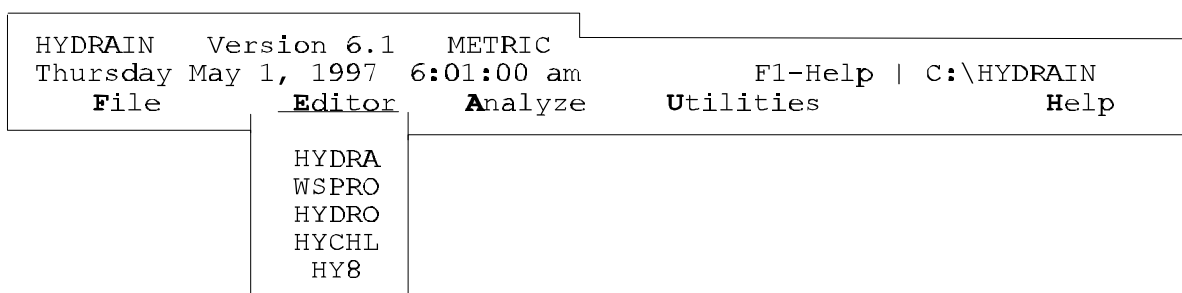
Figure 4. HYDRAIN main menu.

There are five options available in this menu, each having an associated pulldown menu. Each option provides some category of program operation. The **File** options perform file management operations, shell to DOS, or leave the program. The **Editor** options create or edit new and existing input files using the HYDRAIN editor. **Analyze** options execute engineering programs or, for some programs, the interactive editors. **Utilities** options change drives, directories, and update the system configuration. **Help** options access long help for selected HYDRAIN topics.

Two other forms of help are available throughout the HYDRAIN system. Context sensitive help provides the user with brief, but detailed information regarding functions and operations of the program. Active (short) help is constantly displayed at the bottom of the screen for the option on which the cursor is positioned. In addition, more detailed long help is available for many options by pressing <F1>. Once in the long help screen, the text can be scrolled using the , , PgUp, and PgDn cursor keys. Pressing <Esc> will return control to the HYDRAIN program.

There are two ways by which the user might select an option from the main menu:

·　　Use the arrow keys to move the cursor (actually a highlight bar) to the desired option. Press <Enter> to select an option. This method may be employed in every menu in the HYDRAIN system.

·　　If a letter in an option of a HYDRAIN menu (or submenu) is **highlighted**, pressing that letter will invoke the associated option. For example, notice that the main menu highlights the "**A**" in **A**nalyze. Pressing <**A**> will select the analyze option. It is equivalent to manually moving the cursor to **Analyze** and striking <Enter>.

The next section discusses the menu categories and options in more detail. The discussion provides an overview of the category (i.e., File, Editor, Analyze, Utilities, and Help). After each category discussion, the section provides information on each pulldown menu option.

File Menu Category

The HYDRAIN program uses the **File** menu category options to copy, rename, erase, view, & print files; shell to DOS; and leave the program. The options are: Copy, Rename, Erase, View, Print, DOS Shell, and Exit. Figure 5 depicts the menu options in the **File** menu category. Select the **File** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**F**> key.

```
HYDRAIN   Version 6.1    METRIC
Thursday May 1, 1997  6:01:00 am            F1-Help | C:\HYDRAIN
   File         Editor    Analyze    Utilities            Help

   Copy
 Rename
   Erase
   View
   Print
 DOS Shell
   Exit
```

Figure 5. File pulldown menu.

The pulldown menu system uses a subset of cursor keys to move and scroll through options. **Arrows** move cursor up, down, left, or right through the menus. Moving left or right automatically moves to the next pulldown menu. (In some other application programs, the cursor must first move to the top menu, over, and back down.) <Esc> cancels menu or dialog operations, returning to the active window. <Enter> selects and performs the current option (designated by the cursor). **H**ighlighted characters select an operation or option. Striking the highlighted character is equivalent to moving to the option and pressing <Enter>.

Copy pulldown option

The **Copy** function is used to copy a file located on the current drive and directory to a file found at any location. Select the **Copy** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**C**> key. After selecting this option, the HYDRAIN program displays the screen depicted in figure 6.

The screen lists all of the files in the current drive and directory. When presented with the list of files, such as the one in figure 6, choose the Source File by moving the cursor and pressing <Enter>. Should there be more files than can fit on the screen, use the cursor keys to scroll files into view. In this example, the file **YOUNG.LTR** was selected.

```
HYDRAIN    Version 6.1     METRIC
Thursday May 1, 1997   6:01:00 am              F1-Help | C:\HYDRAIN
     File          Editor     Analyze     Utilities               Help

   Copy
 Rename
   Erase          - HYDRAIN System ??? File Catalog -
   View
   Print        Status :    32 file(s) found
 DOS Shell
   Exit         Current Path : C:\HYDRAIN_____
                Current File : _____

                HYDRAIN  EXE   148000   05/01/1997   06:01
                ROUTE95  HDA     4108   05/01/1997   06:01
                HYDRO1   HDO      722   05/01/1997   06:01
                README   1ST     4546   05/01/1997   06:01
                YOUNG    LTR    18885   05/01/1997   06:01
                HYDRAIN  CNF      801   05/01/1997   06:01
```

Figure 6. Copy option source file menu.

As depicted in figure 7, a second screen appears with the selected name appearing in a field called *Copy Source File*. A second *Copy Target File* field is highlighted. This is where the user should type the filename to which the copied file should go. In figure 7, the file name **JONES.MEM** is in this second target field. This indicates that the user wishes to copy **YOUNG.LTR** (found in the HYDRAIN directory) to **JONES.MEM** (to be placed in the current working directory). When this information is entered, press <Enter> to execute the copy and return to the main menu. The file will be copied into the default directory. To change to a new drive, path, or filename, simply retype them when entering the desired filename and pressing <Enter>. The user can return to the HYDRAIN main menu by pressing <Esc>.

```
 HYDRAIN    Version 6.1    METRIC
 Thursday May 1, 1997  6:01:00 am            F1-Help | C:\HYDRAIN
    File         Editor      Analyze     Utilities              Help

   Copy
  Rename
   Erase        Copy Source File:  C:\HYDRAIN\YOUNG.LTR_
   View         Copy Target File:  JONES.MEM_____
   Print
  DOS Shell
   Exit
```
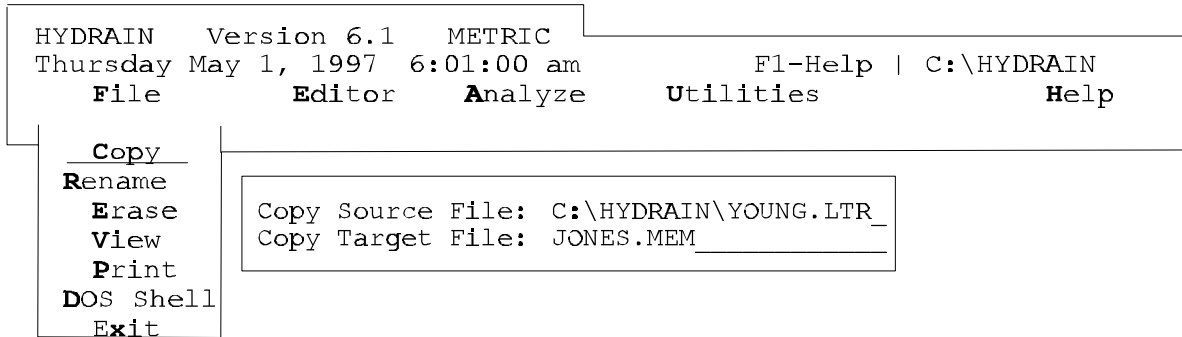
Figure 7. Entering target file in the copy option.

Rename pulldown option

The **Rename** function allows the user to rename any file in the current drive and directory. Select the **Rename** option by moving to the option with cursor keys and pressing <Ent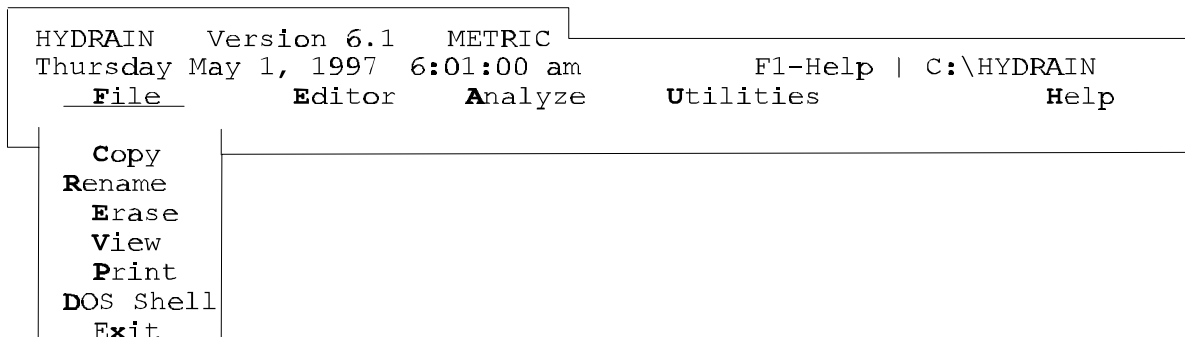er>. Another method is to press the highlighted <**R**> key. The operation of the Rename function is parallel to the Copy function. A screen similar to the one depicted in figure 6 will appear. Select a file to be renamed by moving the cursor and pressing <Enter>. Then type a new name for the file and press <Enter> to enact the command. As before, the new name can be changed by reentering it before <Enter> is hit. Press <Esc> to return to the File pulldown menu.

Erase pulldown option

The **Erase** function allows the user to delete one or more files from the current drive and directory. Select the **Erase** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**E**> key. Once the option is activated, a listing of available files is given on the screen. To select a file to be deleted, move the cursor to the file and press <Enter>. The Erase function depicts selected (or marked) files by using reverse video or having the same features as the menu bar. A highlighted field locates the cursor position in the file listing.

The mark may be removed by moving the cursor to the file and pressing <Enter> again. More than one file may be marked for deletion at any time. Figure 8 shows a file listing with several files marked for deletion. The cursor is on the file **HYDRN.HLP**; the files *BADFILE.YUK*, *OOPSFILE.NO*, and *ERASE.ME* have all been marked for erasure.

```
  HYDRAIN    Version 6.1     METRIC
  Thursday May 1, 1997  6:01:00 am              F1-Help | C:\HYDRAIN
      File          Editor      Analyze     Utilities            Help

        Copy
      Rename
       Erase      ┌──────────────────────────────────────────────────┐
       View       │ Directory: D:\PPFP\HDOC\                          │
       Print      │ Status: 34 file(s) found                         │
      DOS Shell   │ Use ↑, ↓, PgUp, PgDn to View Directory           │
       Exit       │ 'Enter' Marks Files - F3 Deletes Files           │
                  │                                                  │
                  │ HYDRAIN   EXE   148000   05/01/1997   06:01      │
                  │ HYDRNI    HLP     9108   05/01/1997   06:01      │
                  │ HYDRN     HLP    55722   05/01/1997   06:01      │
                  │ HYEDT     EXE   100383   05/01/1997   06:01      │
                  │ BADFILE   YUK    18885   05/01/1997   06:01      │
                  │ HYEXE     EXE    11801   05/01/1997   06:01      │
                  │ OOPSFILE  NO     14285   05/01/1997   06:01      │
                  │ HYDRAIN   CNF      801   05/01/1997   06:01      │
                  │ ERASE     ME      1895   05/01/1997   06:01      │
                  │                 ────────────────────────         │
                  │        3 Files Marked For Deletion ...           │
                  │                                                  │
                  └──────────────────────────────────────────────────┘
```
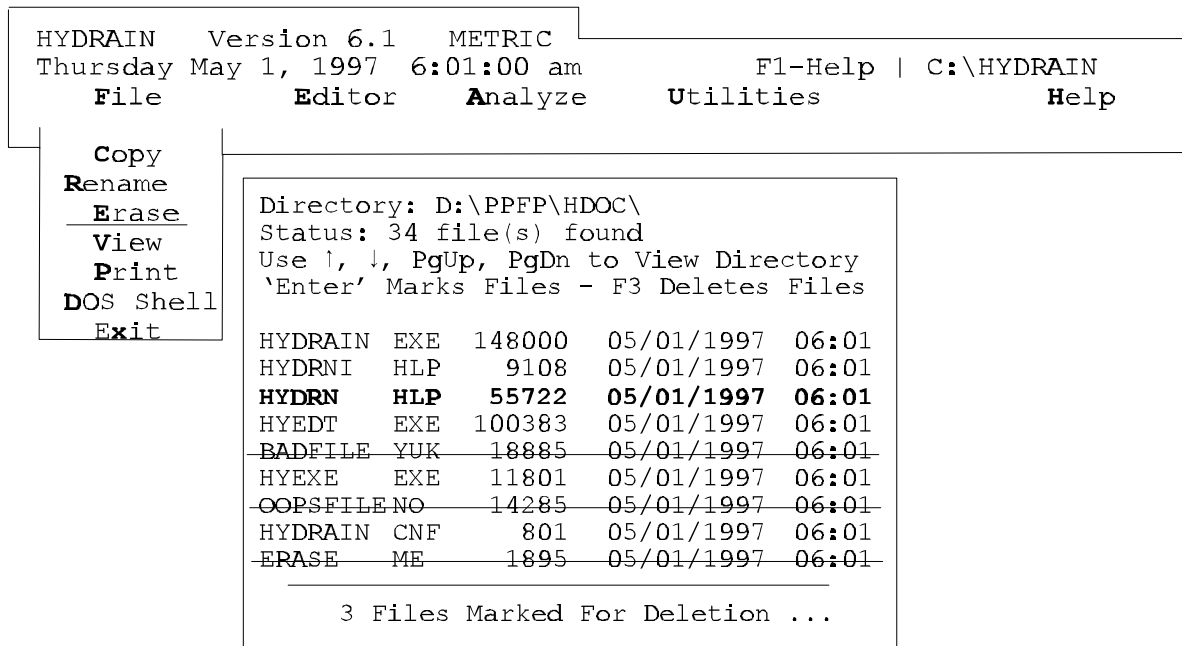
Figure 8. Selecting files to be deleted.

To delete these files, press <F3>. The intent is to give the user ample opportunity to reconsider before deleting a group of files. The result of striking <F3> will be a re-listing of the files on the current drive and directory **without** those files that have been deleted. The fact that a file is not shown on the screen does not necessarily mean that it is not in the directory. If the screen appears full, use the cursor keys to scroll through the list of files to see if any more are present. To return to the File pulldown menu, press <Esc>.

View

The **View** option allows the user to look at the contents of any file on the current drive and directory. Select the **View** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**V**> key. After choosing View, the screen displays a listing of all the files in the specified directory. Choose the file to be viewed by moving the cursor and pressing <Enter>. When the contents of the file are displayed use the arrow, <PgUp>, and <PgDn> keys to view the text. Wide text can be viewed by right and left scrolling using the arrow keys. To exit and return to the File pulldown menu, press <Esc>.

Print

The **Print** option allows the user to print the contents of a file on the current drive and directory. Select the **Print** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**P**> key. After choosing Print, the screen displays a listing all of the files in the specified directory. Choose the file to be viewed by moving the cursor and pressing <Enter>. Unlike the Review option, the contents of the file are printed rather than displayed on the screen. Before attempting to print a file, be sure that the printer is

attached to the system and is ON-LINE. Otherwise, the HYDRAIN program will "blow up." For instance, if there is no printer connected to the terminal, HYDRAIN will attempt to send data to this nonexistent device. The result is a program failure.

DOS Shell

The **DOS Shell** option reenters DOS while keeping the HYDRAIN program resident in memory. The option satisfies the requirement that sometimes arises to temporarily go to DOS, possibly to use a word processor or a spreadsheet. Select the **DOS Shell** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**D**> key. The user will be placed into DOS with the screen resembling that shown in figure 9.

The IBM Personal Computer DOS
Version 3.10 (C)Copyright International Business Machines Corp 1981, 1985
**   (C)Copyright Microsoft Corp 1981, 1985**

Type EXIT to return to Program.
C:\HYDRAIN>

Figure 9. DOS prompt.

Operate normally within DOS and type **EXIT** to return to HYDRAIN. It is important that users type **EXIT** and do not reenter HYDRAIN "normally" or forget that they were in HYDRAIN and move on to other applications. To assist in the prevention of this occurrence, the DOS prompt has been temporarily altered to remind the users that, although they are using DOS, they are still active in HYDRAIN.

Exit

The **Exit** option allows the user to leave the HYDRAIN program. This is the correct method to use to return to DOS. Select the **Exit** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**X**> key. To exit the program from anywhere in the pulldown menus, press <Ctrl+X>. This key combination automatically moves to this option and ends the program.

Editor Menu Category

　　　　The HYDRAIN program uses the **Editor** menu category options to access the HYDRAIN editor, HYEDT. The HYDRAIN editor allows the user almost complete freedom to edit command line input files. Use of this editor assumes that the user has a basic working knowledge of the HYDRAIN editor program and its requirements. As seen in figure 4, the user can apply the editor to six engineering programs; HYDRA, WSPRO, HY8, HYDRO, and HYCHL. Each of these programs can operate in batch mode. (Details on the HYDRAIN editor are found in appendix A. The more specific instructions, in the appendix, take the user through the editing process in a step-by-step manner. Specifications and proper use of the editor are also provided in that area of the documentation.) Select the **Editor** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**E**> key.

　　　　Selecting the Editor menu moves the user to the pulldown menu. Select an option by using the arrow keys to move the cursor to the desired program. Once the cursor is in the correct position, pressing <Enter> will activate the selection. A popup file access menu, as seen in figure 10, will appear on the screen.

```
HYDRAIN    Version 6.1    METRIC
Thursday May 1, 1997  6:01:00 am              F1-Help | C:\HYDRAIN
    File           Editor     Analyze     Utilities              Help

          HYDRA
          WSPRO
          HY8           - HYDRAIN System HDA File Catalog -
          HYDRO
          HYCHL      Status :    28 file(s) found

                     Current Path : C:\HYDRA_____
                     Current File : _____

                     HLPFS     HDA     628    05/01/1997   06:01
                     ROUTE95   HDA     623    05/01/1997   06:01
                     HYDRA1    HDA    3855    05/01/1997   06:01
                     HYDRA2    HDA    1146    05/01/1997   06:01
                     HYDRA3    HDA    5658    05/01/1997   06:01
                     HYDRA4    HDA    1232    05/01/1997   06:01
```

Figure 10. File access screen.

　　　　The first field of the screen shows the path of the input files of the program selected. The HYDRAIN program only displays those files having the default extension (HDA, WSP, HDO, INP, or CHL) that is appropriate for the selected engineering program.

　　　　To create a new file (or use a file that does not use the default extension), enter the desired name and press <Enter>. This action activates the HYDRAIN editor. To select a file from those already existing, move the cursor to the appropriate name and press <Enter>. The default drive and path can be changed using the first field. After entering the name and pressing <Enter>, the files in that path, having the appropriate extension will appear. If no files exists, a

message to this effect will appear at the top of the window. Using default HYDRAIN extensions is not a requirement, but, as will become evident with continued use of HYDRAIN, doing so makes operations much easier. Return to the Editor pulldown menu at any time by pressing <Esc>.

<u>Analyze Menu Category</u>

The HYDRAIN program uses the **Analyze** menu category options to choose one of the eight engineering programs. These options are shown in figure 11. Select the **Analyze** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**A**> key. The Analyze menu categorizes engineering programs as being from one of two categories; batch or interactive execution.

- · HYDRA, WSPRO, HYCHL, and HYDRO are known as **BATCH** programs (this is not to be confused with a DOS Batch file). This means that they assume that any data they use to solve a problem already exists and is in a separate input data file. After program execution, the results calculated by the program are placed in a separate output file. This approach is similar to how mainframe programs process information.

- · HY8, NFF, and HYEQT are **INTERACTIVE** programs.[5] Also, HYCHL and WSPRO are available in interactive form. Interactive means they combine data entry and program execution together. For example, HY8 will collect data, calculate intermediate output, collect more data and calculate more information, and so on until the problem has been completed. The user is an element of the process. Choosing any of the interactive programs will cause HYDRAIN to directly invoke the interaction execution process.

If selecting one of the batch programs, the user must choose an input file before execution can commence. Similar to the Editor option, a popup file access menu assists in this selection process. The user may choose an already existing file from those displayed by moving the cursor and pressing <Enter>, or, they might enter a filename in the second field.

---

[5]When selecting WSPRO, HYCHL, or HY8 from the Editor menu, HYDRAIN treats them as a BATCH program. The INTERACTIVE modes of these programs are only active when accessed through the Analyze menu.

```
 HYDRAIN    Version 6.1     METRIC
 Thursday May 1, 1997   6:01:00 am                  F1-Help | C:\HYDRAIN
      File          Editor      Analyze       Utilities                  Help

                                 HYDRA
                                 WSPRO
                                 HY8
                                 HYDRO
                                 HYCHL
                                 NFF
                                 HYEQT
```
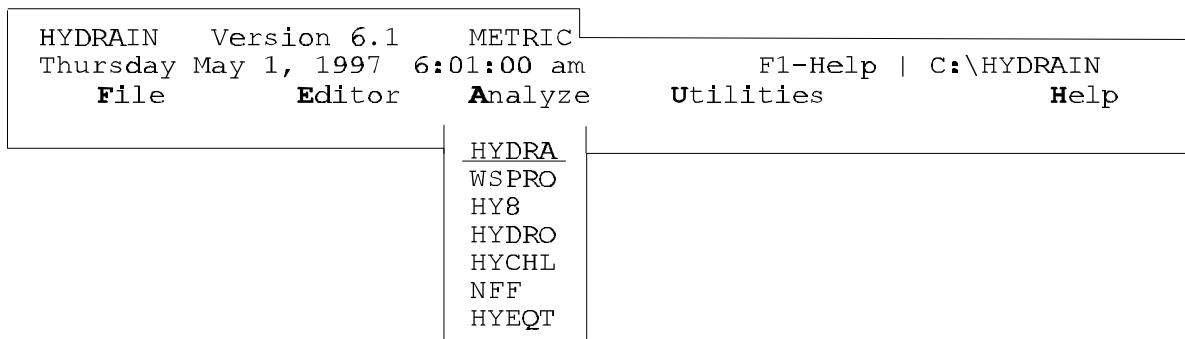
Figure 11. Analyze option pulldown menu.

One reason the user might use this option is to run a file which has a different extension than the one for the program. For example, HYDRA program files will most often have the **.HDA** extension. If, however, a HYDRA file has a .DAT extension, this option would be used to select that file. Because of the nature of the HYDRAIN file management module, these non-default extension files will not appear as available selections, **even though they may exist on the correct input drive and path**.

After a file is selected, the program is run and the output will be displayed. Again, pressing <Esc> will return the screen to the Analyze pulldown menu.

Utilities Menu Category

The HYDRAIN program uses the **Utilities** menu category options to perform maintenance and configuration functions. Figure 12 displays the pulldown menu for this option. These functions are described below. Select the **Utilities** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**U**> key.

```
 HYDRAIN    Version 6.1     METRIC
 Thursday May 1, 1997   6:01:00 am                  F1-Help | C:\HYDRAIN
      File          Editor      Analyze       Utilities                  Help

                                          View Directory
                                         Change Directory
                                           Change Drive
                                           Change Paths
                                          Screen Colors
                                           Device Ports
                                           Change Units
```
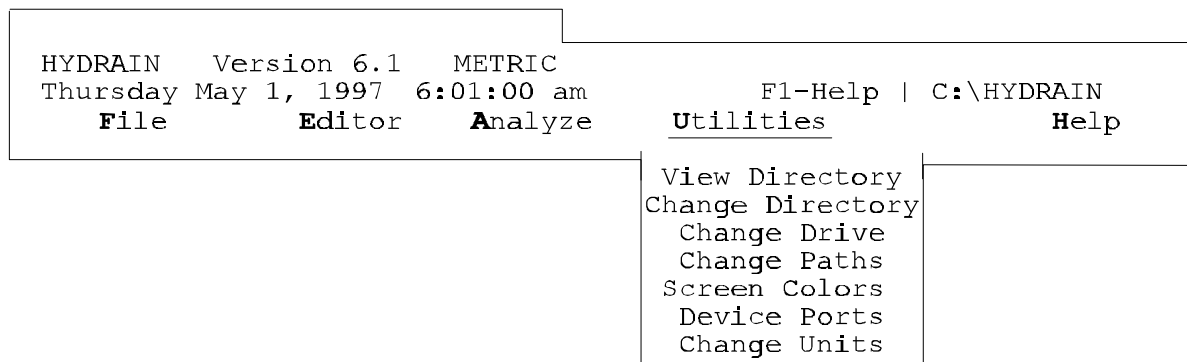
Figure 12. Utilities option pulldown menu.

View Directory

The **View Directory** option views a listing of all of the files on the current drive and directory. Select the **View Directory** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**V**> key. After selecting this option, all pertinent information about the files and the directory is given. Use the arrow, <PgUp>, and <PgDn> cursor keys to view additional files. The list of files shown are in no particular order, so if an expected file is not seen, scroll down the list until it is found.

Change Directory

The **Change Directory** option changes the directory used as a default throughout the HYDRAIN system. Select the **Change Directory** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**C**> key. After selecting this option, the HYDRAIN program displays a popup menu that displays the default directory. (The current default directory is always displayed in the upper right corner of the screen.) To change the default, move the cursor to **Prior Level** and press <Enter> or move to one of the listed subdirectories and press <Enter> (**Prior Level** and **Current Level** will not appear if the user is on the Root Directory). If the current directory was C:\HYDRAIN, selecting **Prior Level** would take the user to the root directory.

The next screen would list all of the first level directories available on the current drive. Select a directory by moving the cursor and pressing <Enter>. Once a first (or larger) level directory has been reached, selecting **Current Level** will return the user to the Utilities pulldown menu. Pressing <Esc> also returns control to the Utilities pulldown menu. **Note:** there may be more directories than are immediately shown on the screen. In this case, simply use the cursor keys to scroll down until all available directories are in view.

Change Drive

The **Change Drive** option changes the default disk drive. Select the **Change Drive** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**D**> key. After selecting this option, a popup menu displays the current default and other available drive on the system. To change the drive, move the cursor and press <Enter>. The display at the top of the popup menu and the current path in the upper right screen will change accordingly. After the desired drive is selected, use the<Esc> keys to return to the Utilities menu. If the selected drive is a floppy disk device, be sure to insert a diskette inside the drive before using this function!

Change Paths

The option **Change Paths** indicates where to find input, output, executable, and help files for the various HYDRAIN programs. Select the **Change Paths** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**h**> key. The resulting popup menu lists all current programs and module in HYDRAIN. To select an option, move the cursor and press <Enter>, or, type the letter which is highlighted for the desired option.

The HYDRAIN option lets the user tell the program where to find the HYDRAIN executable and help files. It is also the option that allows changes to the INTERMEDIATE PATH. (Recall that the intermediate path defines the directory to which shared files and output used by other programs may be sent. By sending output to the specified directory, it will be readily available for retrieval into another program. For example, if the output from a given program is in the form of a hydrograph, the data describing the hydrograph might be sent, via the intermediate path, to a new file. This data might then be retrieved directly into a program that requires the input of a hydrograph. Use of the Intermediate Path option saves the user a great deal of time.)

To change the path, move the cursor to the appropriate field and enter the new drive and directory. It is important to note that changing the drive and/or directory does not automatically switch files from the old drive/directory to the new one. It is the responsibility of the user to ensure that the files for which the program will be searching are moved or copied to the new directory. To exit the HYDRAIN option and return to the Change Paths popup menu, press <Esc>.

If selecting the engineering program options (i.e., HYDRA, WSPRO, HYDRO, HYCHL, HY8, NFF, and HYEQT), the program displays a dialog menu having four lines for user input. The first asks the user to specify where the executable program file location. The second specifies where program input files can be found. The next provides a field for entering the output file destination. Finally, the last field specifies the location of help files for the given program. The current settings are displayed and can be changed by moving the cursor to the desired field, typing the new drive and directory, and pressing <Enter>. When the proper path selections has been made, select **Update** to save the path changes. Select **Cancel** to return to the Utilities pulldown menu without affecting any path changes.

Screen Colors

The **Screen Colors** options allows changes to default colors schemes for the HYDRAIN system. Select the **Screen Colors** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**S**> key. The resulting Screen Colors popup menu, shown in figure 13, has seven available options and a matrix of 128 possible color combinations. (Hercules and monochrome graphic monitors will get the same matrix, although many combinations will appear the same.)

```
 HYDRAIN    Version 6.1    METRIC
 Thursday May 1, 1997  6:01:00 am          F1-Help | C:\HYDRAIN
      File          Editor     Analyze     Utilities              Help

                                          View Directory
                                         Change Directory
      Desktop    ■    Color Matrix         Change Drive
     Menu Text   ■  ■■■■■■■■■■■■■■          Change Paths
    Menu Cursor  ■  ■■■■■■■■■■■■■■         Screen Colors
    Hilite Keys  ■  ■■■■■■■■■■■■■■          Device Ports
    Active Help  ■  ■■■■▲■■■■■■■■■          Change Units
     Long Help   ■  ■■■■■■■■■■■■■■
    Status Text  ■  ■■■■■■■■■■■■■■
       Update       ■■■■■■■■■■■■■■
       Cancel       ■■■■■■■■■■■■■■
```
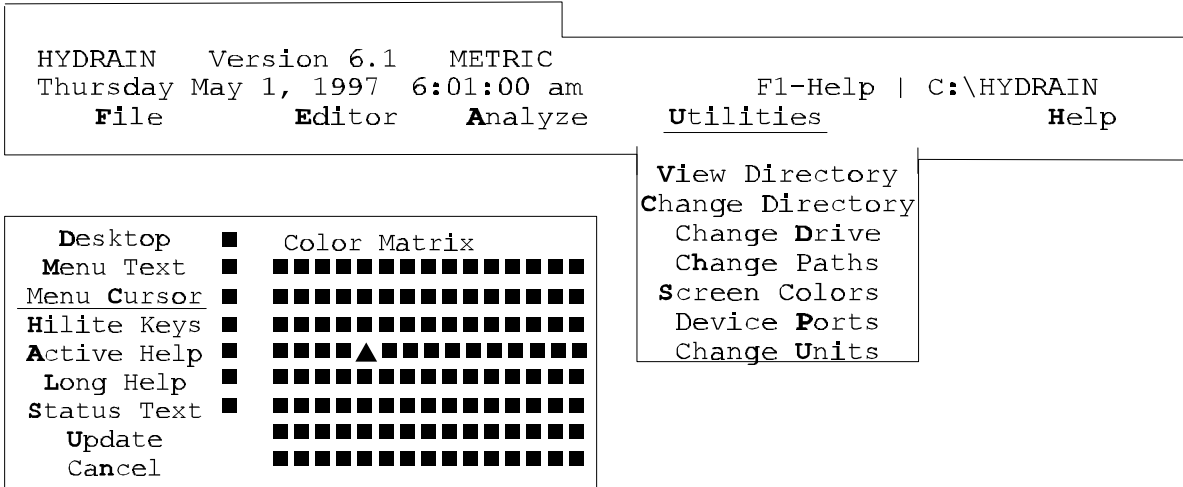
Figure 13. Screen colors matrix.

Choose the item for which the colors are to be changed by moving the cursor and pressing <Enter> or by pressing the highlighted letter in the desired option. When an item from the menu is chosen and the cursor is moved within the screen colors matrix, the corresponding part of the current display is changed.

If the option **Desktop** is chosen, moving the cursor in the matrix will change the background color of the display. Similarly, the cursor bar will change if the **Menu Cursor** option is selected.   Manipulating the **Menu Text** option will affect the color of the menus, while selecting **Hilite Keys** will change the letter in each menu selection. Choosing **Active Help** and moving the cursor will affect the color of the short help at the bottom of the display. The **Long Help** option will allow the user to manipulate the color of the text in *Help Screens*, while choosing **Status Text** will allow the user to alter the color of messages at the top and the bottom of the screen.

From the color matrix, press <Enter> to return to the Screen Colors popup menu. The user may then choose to alter various other parts of the screen. Experiment with the different color combinations until finding one which is both practical and aesthetically pleasing. When all changes have been made, select **Update** to save the changes which have been made from the Screen Colors popup menu. Select **Cancel** to return to the original color combinations.

Device Ports

The **Device Ports** option allows changes to the hardware that is attached to the printer. Select the **Device Ports** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**P**> key. Appearing after either of these two actions occur, the Device Port popup menu provides a listing of parallel and serial ports common to most microcomputers. Also present is the option **None** which should be used if no printer is attached to the system. (This is the default option at installation.)

The popup menu displays both the existing device setting and any current selections made while in the menu. When the proper port selection has been made, select **Update** to save the port change. Select **Cancel** to return to the Utilities pulldown menu without affecting any port changes.

Change Units

The Change Units option allows either the metric unit system or English unit system to be chosen as the default unit for the engineering programs. (The default unit is selected at installation and can be changed with this option.)

Help Menu Category

The HYDRAIN program uses the **Help** menu category options to provide the user with six options that focus on specific HYDRAIN topics. Figure 14 displays the pulldown menu for this option. Select the **Help** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**H**> key.

```
HYDRAIN     Version 6.1     METRIC
Thursday May 1, 1997  6:01:00 am              F1-Help | C:\HYDRAIN
    File          Editor     Analyze      Utilities              Help
                                                        General
                                                       Main Menu
                                                        Keyboard
                                                       File Names
                                                       References
```
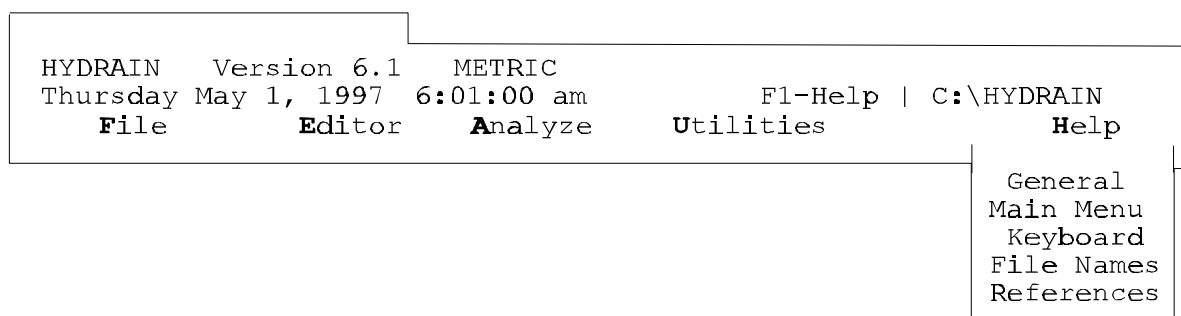
Figure 14. Help pulldown menu options.

SUMMARY OF OPERATIONS

Entry to engineering programs is via the HYDRAIN program. Table 1 lists other operations. The table reveals that for most of the programs, multiple methods exist to perform these system operations.

Table 1. HYDRAIN system operations.

Engineering Program	Input* Generation	Editing Input Data	Run* Control	Input & Output Review/Print
HYDRA	HYEDT or Editor**	HYEDT or Editor**	HYDRAIN Program or HYEDT	HYDRAIN Program or HYEDT
WSPRO	WSSHL or Editor**	HYEDT or Editor**	HYDRAIN Program or HYEDT	HYDRAIN Program or HYEDT
HYDRO	HYEDT or Editor**	HYEDT or Editor**	HYDRAIN Program or HYEDT	HYDRAIN Program or HYEDT
HY8	HY8 Program, HYEDT or Editor**	HYEDT or Editor**	HYDRAIN Program or HYEDT	HYDRAIN Program or HYEDT
HYCHL	CHSHL, HYEDT or Editor**	HYDRAIN Editor or Text Editor**	HYDRAIN Program or HYEDT	HYDRAIN Program or HYEDT
HYEQT	HYEQT Program	HYEQT Program	HYEQT Program	HYEQT Program
NFF	NFF Program	NFF Program	NFF Program	NFF Program

*All programs except NFF and HYEQT can use batch file operations. NFF and HYEQT secure data from the user as they are processing. HYCHL and HY8 can operate in either interactive or batch mode.

**Note - indicates that either a text editor, word processor or line editor could be used in the specified operation.

APPENDIX A: THE HYDRAIN EDITOR

The HYDRAIN editor (HYEDT) is an application program that provides a consistent means to add new or change existing data. The HYDRAIN editor uses the entire display screen and possesses advanced data manipulation abilities. The HYDRAIN editor orientation of HYEDT is towards command line input data sets, such as used by HYDRA, WSPRO, HYDRO, and HYCHL engineering programs. The editor allows review of output files and external files without leaving the program. It can process extended (long) context-sensitive help to assist in developing or debugging input data. The editor uses common user access (CUA) guidelines whenever possible to ensure consistency with other software products. The HYDRAIN editor achieves this mixture of features by dividing operations between data/text (windows) and menu/dialog portions. Figure 15 shows the editor screen containing input data and with a menu activated.

HY8 input files can also be viewed and edited directly using the HYDRAIN Editor. Care should be taken, however, when modifying HY8 input files, as many of the values are calculated by the HY8 interactive program. The facility to review and edit these files in the HYDRAIN Editor has been added to facilitate viewing and understanding the HY8 INP files. Changes to these files should usually be accomplished through the HY8 interactive program.

```
  File         Edit        Search       View         Help             WSPRO 6.1 Metric
                           +))))))))))))))),
*F *                       * Find...        *
T1 *          EXAMPLE O* Repeat Find   * FLOW
T2 *              HYD* Change...        *
T3 *                   .))))))))))))))))-
Q  *1423    3145    4207
WS *454.0    456.5   457.02
XT *SURVY   2500
GR *-90.0,465.0     0.0,461.0     45.0,457
GR *150.0,455.4   160.0,450.3   188.0,450
GR *276.0,458.0   344.0,458.0   430.0,461
XS *GAGE   1000
GT *-2.2
N  *0.110    0.080    0.040    0.065    0.
SA *      99       150      210        276
XS *XS2   1500   *   *   *   0.002
XS *XS3   2000   *   *   *   0.0012
XS *EXIT   2365
XS *FULLV  2485
XS *APPR  2635
XS *XS4   3000
XS *XS5   3500
Help: Search for specific data within the active window.
File: \WSPRO\UNC.WSP                                0002:00      Alt=Edit  F1=Help
```

Figure 15. Typical HYDRAIN editor screen.

WINDOWS

Three windows contain the input data, extended (long) help text, and output/file data. The use of the term "window" indicates that each data area "views" a separate aspect of the engineering problem. The input window contains the command line data and parameters. This window is the raw information required to perform an engineering analysis. The long help window contains detailed information on each command used in the input window. Analogous to a reference material or dictionary, use extended help to clarify a concept, or for deeper understanding of an issue. The output window contains analysis results or retrieves any additional data.

<u>Moving Within Windows</u>

The three windows use the same set of cursor keys to move or scroll the data. The keys and their respective actions are:

· **Arrows** - move cursor up, down, left, or right through a window. The editor will scroll, as needed, to display additional text or data within the window.

· **PgUp** - moves the cursor position up an entire screen of data (a screen is the quantity of data viewable in a window).

· **PgDn** - moves the cursor position down an entire screen of data.

· **Home** - moves cursor to the first column in the current row.

· **End** - moves cursor to the last column in the current row.

· **Ctrl+Home** - moves cursor to the top of the document. (In this documentation, the notation *Crtl+Home* means to simultaneously press the Crtl and Home keys.)

· **Ctrl+End** - moves cursor to the bottom of document.

· **Ctrl+Arrow** - moves cursor to next field or parameter.

· **Tab** - moves cursor to next field or parameter (identical to Crtl+Arrow operation).

As will be seen, many of these keys are active within other portions of the editor. The next section discusses each window in more detail.

Input Window

The input window is the primary data area in the HYDRAIN editor. It is the only window that permits creation, changes, or additions to a file. Oriented to command line input files, the input window contains two fields–one for commands and one for parameter data. The command field contains three spaces (reflecting the maximum command length in the engineering programs). The width of the second field equals 77 characters. The total width of the input window equals 80 characters. The input window may contain up to 1000 lines of input data.

The editor tracks movement and location by a cursor that appears in the window. Additionally, the lower right corner of the screen displays the current row and column. In the input window, this screen location also displays **CMD** when in the first (command) field, and the parameter count when in the second field. (The parameter count is useful in keeping track of recursive data.)

The cursor position also controls short (or active) help messages. Short helps are one-line, context-sensitive messages that provide information about input data. If the cursor is within the first field boundaries, the short help text corresponds to the last valid command entered in the field. If the input window is empty (or the command is invalid), the editor displays a message to that regard. If the cursor is within the second field (columns 4 through 80), the short help prompts for the parameter data. As mentioned earlier, the editor "counts" the number of parameters entered. HYEDT provides some checks for non-recursive commands. Should the parameter count exceed the maximum number of parameters for a given command, the editor provides a message to that effect. (This check does not occur for recursive command; for example, a listing of x and y coordinates.) The short help message location is at the bottom of the screen.

Besides the cursor keys used to move within the window, the input window uses additional editing keys. (These keys remain inactive in the other two windows.) The input window editing keys and their respective actions are:

- **Ins** - toggles between *insert* and *replace* modes. The editor indicates the insert mode with a blinking underline cursor and the message **Ins** in the lower right portion of the screen. The editor indicates the replace mode with a blinking box cursor and the message **Rep** in the lower right portion of the screen. (The **Ins** key may toggle in the other windows, but no editing activity takes place.)

- **Del** - deletes the character or space at the current cursor position.

- **Backspace** - moves cursor to left, deleting the character or space in the new cursor position.

- **Enter** - adds a row below the current cursor position.

- **Alt+D** - deletes row at current cursor position.

· **Space Bar** - adds "hard spaces" to a data field. The editor distinguishes between hard spaces and moving across the input window with the arrow keys. (Just like any other text editor or word processor, there are no implicit spaces added until done so by the user.)

The editor recognizes only two characters as valid delimiters. These delimiters are the hard space "_" and the comma "," characters. The editor considers consecutive occurrences of either delimiter as equivalent to a single delimiter. This is important in keeping track of the current parameter and the context-sensitive short help. A consequence of this feature is that the editor considers a blank, enclosed by commas (i.e., ",_,_,") as the same as a series of spaces. This affects engineering programs that use such a scheme in their input data sets. (Sometimes programs consider a blank surrounded by commands to equal a zero--HYEDT does not.)

The input window has automatic "wrap around" (or continuation) capabilities for command strings greater than 80 columns. HYDRAIN input conventions denote continuation of lines by leaving the subsequent command field blank and placing the additional data on the parameter field. Figure 16 depicts an example of command data continuing to the next row. (Notice the cursor is on row 5, column 61.) The editor attempts to preserve hard spaces when the data wraps. The wrap around feature does not reset the parameter counter. (The parameter counter indicates that the cursor is on the eighteenth parameter.)

```
  File      Edit       Search      View       Help
rem*Downstream Channel Data
XS *0.0  0.0  0.0025
GR *0.0,  106.5    25.0, 104.4    45.0, 102.0     55.0, 100.0    62.0, 98.0
   *70.0, 100.0    80.0, 102.0    100.0 105.0     125.0, 106.5
   *
   *
   *
   *
   *
   *
   *
   *
   *
   *
   *
   *
   *
   *
   *
Help: y-coordinate distance above common elevation datum, in feet.
File: C:\WSPRO\EX1.WSP                              Ins    0005:061:018
```

Figure 16. Automatic continuation of input data to next row.

Some engineering programs designate continuation by repeating the command in subsequent command fields. The editor considers these commands as new commands.[1] One result is the parameter counter resets to one. If parameter sets remain in order, this type of continuation should not affect the parameter short helps.

If retrieving input files with character width greater than 80 columns, the editor does not "cut off" the extra columns. Instead it attempts to continue these excess columns on the next row. Since no present engineering program allows input widths greater than 80 characters, this feature will not often occur.

Extended Help Window

The extended (long) help window provides additional on-line documentation for commands used to create input data sets. The long help window does not have the same extensive abilities as the input window. None of the editing keys are active within the window. (The **Ins** key does toggle between insert and replace modes, but the editor does not alter any help text.)

The help window contents are reproductions of the command documentation for each specific engineering program. The help window format begins with general command information and becomes progressively more specific when moving deeper into the text. The beginning of the help text consists of the command name and a short description. (This short description is often the same as the command short help.) Next, the text provides the command purpose and typical structure or parameter layouts. After the parameter layout, the help text includes detailed information regarding each parameter. This information includes units, if appropriate. (Consider this detailed parameter information to be more insightful than the parameter short helps.) The final portion of the extended long help text usually contains notes on the proper usage and requirements of the specific command. In the extended help window, the editor displays the last short help message produced by the input window (or menu option). In this case, the short help serves as an index to the parameter or command at which queries began.

Unlike the input window, there is only a single field. The field in the extended help window contains text that is 78 characters wide. The help text length may extend for several hundred rows, depending on the complexity of the command. (Most of the help text lengths are much less.) The editor reads the long help text from the hard disk, as necessary. (This saves memory.)

Output/File Window

The output window provides the editor with three specific functions. First, this window displays the results of an engineering analysis. (The editor executes the engineering program,

---

[1]It is not feasible for the editor to distinguish between a continuing command, using this format, and a series of commands, having the same name, ordered sequentially, but being independent of each other.

finds the output file, and reads it in.) The output window also displays any error or system messages that occur during engineering program execution. The final function allows the editor to retrieve text files. These text files may contain information useful for creating an input data file, for example, hydrograph ordinates.

The editor allows the output window to retrieve files up to 127 characters wide and 1,000 lines in length. Larger files may be viewed in another text editor. The fourth example in Volume III illustrates this issue.

The output window uses a temporary default output file name called **UNTITLED.LST**. The editor creates this file when called by the HYDRAIN program and deletes **UNTITLED.LST** when the editor terminates. The editor places the file on the default HYDRAIN directory. Still, it is a good idea not to give any input data set the prefix **UNTITLED** (i.e., **UNTITLED.HDA** for HYDRA) as unforeseen effects may occur during analysis. The editor uses **UNTITLED.LST** to store screen directed messages that occur during engineering program execution. These screen directed output include run-time error messages. After creating an output file (or retrieving a text file), the editor replaces **UNTITLED.LST** with this other file.

Full- and Split-Screen Modes

Each window can operate in full- or split-screen mode. The full-screen mode only displays the current (or active) window. Twenty-one rows of information are available for viewing within full-screen mode. Figure 16 depicted the input window in full-screen mode. The split-screen mode displays two windows simultaneously on the monitor. Each window reveals 10 rows of information for viewing. (In split-screen mode, the editor uses the extra row to display information about the bottom window. This row effectively separates the two windows.)

In both full- and split-screen modes, the windows act as a viewport of the document within. The viewport size is 21 by 80 characters in the full-screen mode and 10 by 80 characters in the split-screen mode. The window display does not change when moving from one window to another unless a change in cursor position has occurred. The next section discusses moving from one screen to another and selecting full- or split-screen modes.

Moving Between Windows

Moving from the active window to another window takes place by using function keys (or, as will be seen later, menu options). The function keys and their actions are:

· **F1** - display extended (long) help. The display becomes split-screen (if not already). The extended help window becomes the active window.

· **F2** - display input window. The input window becomes active. Total editing capability is present.

· **F3** - display output window. The output window becomes active. If no output available for display, empty file "UNTITLED.LST" displayed.

·   **F4** - switch control between windows. This function key only works when in split-screen mode. Only affects windows displayed in split-screen mode.

·   **F5** - display active window in full-screen mode.

By default, the HYDRAIN editor always starts by displaying the input window in full-screen mode. In this case, the input window is the active window. To activate the extended help window, press the F1 function key. This action automatically changes the editor into split-screen mode and makes the extended help window the active window. The input window remains the top window and the help window becomes the bottom window. The active key message (second line from the top of the display) changes to reflect that the extended help window is active. (The F1 ceases to be highlighted, and the F2 becomes highlighted. This means "you can go to the input window (F2) from the help window. You cannot go to the help window (F1) since you are already there.") Figure 17 illustrates the input and extended (active) windows in the split-screen mode.

```
  File     Edit     Search      View      Help
JOB*HYDRA McTrans Problem
SWI*1
HGL*1
NEW*Link One ...
rem*Add flow into system one ....
FLO*0.51
PDA*0.024 12 10 0 0 .001
rem*Assume that all ground elevations are 620.00 feet
PIP*10_620 620 601.45 601.35 -15
PNC*1 2 3 90 0 0


 COMMAND PIP - Circular PIPe

 Purpose: This is one of the transport commands.  It moves water from one
          point to another in a circular pipe.  A PDA command is required
          somewhere in the command file ahead of the first PIP command.

 Structure:
     PIP  length, grup, grdn, invup, invdn, mindia, lscost, trfac, plot

     1) length  - the length of the link or pipe, in feet.
Help:  The length of the link or pipe (feet).
File: "PIP" COMMAND                                              0001:001
```

Figure 17. Editor in split-screen mode.

There is a visual hierarchy (of sorts) that occurs when switching between windows. The input window always appears as the top window. The output window appears below the input window. If the output window is active and a switch is made to the long help window (using

F1), the output window becomes the top window and the help window moves to the bottom. In other words, the input window "outranks" the output window which "outranks" the help window.

The active split-screen window becomes full-screen mode by pressing the <F5> key. The contents of the "non-active" windows are not lost. The editor considers the other window(s) present, but hidden "behind" the active window.

As an example, suppose the input window is empty (or new). Entering the command **JOB** in the first field activates the active short help line (at the bottom of the screen). The active key(s) message depicts that, at least, <F1> has information (since <F1> is highlighted). Pressing <F1> moves to the extended help window (seen in figure 22). Pressing <F5> provides full-screen help. Pressing <F2> returns to the input window (making it active), but makes the display split-screen. The editor still displays the long help, but given the hierarchial nature of the windows, it is on the bottom.

MENUS AND DIALOGS

The editor uses a series of menus and dialog windows to provide additional and advanced options when creating or editing a file. The editor has five menu categories; each pertains to some general operation. The menu categories are: **File**, **Edit**, **Search**, **View**, and **Help**. (Users of CUA based programs will recognize these menu options.) All have pulldown menus that provide specific options for each category.

The menu system is separate from the three windows. The editor toggles between the window and menu systems. The <Alt> key provides this toggling capability. The menu system activates by pressing <Alt> from any of the three data windows. Pulldown menu options associated with editing functions are not available if the active windows are either the long or output windows.

Each menu option has associated short and long (extended) helps. These helps provide guidance in applying the menu features. (Using the extended help feature (F1) in the menu system returns to the help window with menu option specific text. The display switches to split-screen mode if necessary. To return to the menu, use the <Alt> key.)

Moving Within Menus

The menu system uses a subset of cursor keys to move and scroll through options. The keys and their respective actions are:

- **Arrows** - move cursor up, down, left, or right through the menus. In a pulldown menu, moving left or right automatically moves to the next pulldown menu. (In other application programs, the cursor must first move to the top menu, over, and back down.) The editor menus are not ring menus. (This means that moving right at the **Help** field does not circle back to the **File** field.)

· **Ctrl**+**Arrows** - moves the cursor to the next field or menu option. These keys are more useful in the dialog windows.

· **Tab** - moves the cursor right to the next field or menu option. (Identical to the **Ctrl**+ operation.) This key is more useful in the dialog windows.

· **Shift**+**Tab** - moves the cursor left to the next field or menu option. (Identical to the **Ctrl**+ operation.) This key is more useful in the dialog windows.

· **Esc** - cancels menu or dialog operations, returning to the active window.

· **Enter** - selects and performs the current option (designated by the cursor).

· **H**ighlighted characters - select an operation or option. Striking the **h**ighlighted character is equivalent to moving to the option and pressing <Enter>.

The next section discusses the menu categories and options in more detail. The discussion provides an overview of the category (i.e., File, Edit, Search, View, and Help). After each category discussion, the section provides information on each pulldown menu option, including any special keys or procedures.

<u>File Menu Category</u>

The editor uses the **File** menu category options to create, retrieve, save, & print files; run engineering programs; and leave the editor. The options are: New, Open, Save, Save as, Analyze, Print, and Exit. Figure 18 depicts the menu options in the **File** category. Use the **New** option to create a new file. The **Open** option retrieves an existing file to edit or view. The **Save** option will save the current working file (that is, the file in the input window) under the same name. To save a file under a different name (or for the first time after using the **New** option to create a working file), use the **Save as** option. The editor executes (runs) engineering programs with the **Analyze** option. The **Print** option sends contents of the current window to an output device. The final option, **Exit**, ends the editor program. Select the **File** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**E**> key.

New pulldown option

The **New** pulldown option clears the input window of any existing file and creates a untitled input file. The new file has the temporary name of **UNTITLED.EXT** (where **EXT** is the default extension for the current active engineering program). The newly created file is available to develop a command string for use in analyses. Use the **Save as** option to preserve the file. This allows changing the default file name to a more descriptive (and permanent) file name. Without using the **Save as** option, the editor will not preserve data before selecting succeeding **New** options or when leaving the program. Select the **New** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**N**> key. The option becomes inaccessible depending on the current active window. (For example, when the long command long help is the active window.)

```
   File      Edit       Search      View       Help
+))))))))))))),
* New           *oblem
* Open...        *
* Save           *
* Save as...     *..
* Analyze        *nto system one ....
* Print          *
* DOS Shell     *0 0 0 .001
* Exit          *t all ground elevations are 620.00 feet
.))))))))))))))- 601.45 601.35 -15
PNC*1 2 3 90 0 0
FLO*1.02
PDA*0.024 12 10 0 0 .001
PIP*123.18 620 620 601.35 600.49 -15
PNC*2 4 3 90 0 0
HOL*1
NEW*Link Two ...
FLO*33.91
PDA*0.013 12 10 0 0 .001
PIP*63.75 620 620 599.0 598.74 -36
PNC*3 4 3 180 0 0
REC*1
Help: Create, retrieve, save, & print file; run analyses; exit editor.
File: C:\HYDRA\SAMPLE.HDA                              Alt=Edit  F1=Help
```

Figure 18. File menu category options.

Open pulldown option

The **Open** pulldown option retrieves an existing file into the current window. When selecting this option, the next screen will be a file dialog box showing files on the directory. After selecting a file from the catalog, the editor replaces the existing file (located in the current window) with this newly selected file. The editor guards against accidental overwrites of edited files. If using the **Open** option will cause data loss, the editor provides a warning and allows cancellation of the operation. Select the **Open** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**O**> key. The option becomes inaccessible depending on the current active window. (For example, when the long command long help is the active window.)

Save pulldown option

The **Save** pulldown option writes the contents of the current window to the active file. The editor provides no opportunity to change the file name when using the **Save** option. (Use the **Save as** option to store the file under a different name.) The **Save** option writes over the existing file, destroying the prior data. The editor does not provide notice that this occurs.

The editor automatically saves an input file when using the **Analyze** option. Running a program results in the current input data overwriting the existing data file. Select the **Save** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the

highlighted <**S**> key. The option becomes inaccessible depending on the current active window. (For example, when the long command long help is the active window.)

Save as pulldown option

The **Save as** pulldown option writes the contents of the current window to a file whose name the user creates or selects. When selecting this option, the next screen will be a file dialog box showing files on the directory. The editor displays a field prompting for a file name. The editor guards against accidental file overwriting. If using the **Save as** option will cause data loss, the editor provides a warning and allows cancellation of the operation. Select the **Save as** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**V**> key. The option becomes inaccessible depending on the current active window. (For example, when the long help command is the active window.)

Analyze pulldown option

The **Analyze** pulldown option sends the current input file to the proper engineering program for execution. The editor automatically saves an input file will automatically run using the **Analyze** option. Running a program overwrites the contents of the current window to the data file.

During execution, some engineering programs create status information. The editor captures and displays the status in a window located below the input window. The editor stores status data in a temporary file (**UNTITLED.LST**). The temporary file also holds any compiler error messages that occur during execution. After completing the execution, the editor replaces the temporary file with the output file information. Select the **Analyze** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**A**> key. A third method is concurrently pressing the <**Ctrl**> and <**A**> keys <Ctrl+A> or <Alt+A> to select this option. The option becomes inaccessible depending on the current active window. (For example, when the file browser or command long help is the active window.)

Print pulldown option

The **Print** pulldown options sends the contents of the active window (input, file browser, or long help) to the printer. The editor assumes that the output device port location is LPT1. If errors occur during printing, the editor will try to determine the trouble and provide an applicable message. Select the **Print** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**P**> key.

DOS shell

The **DOS Shell** option reenters DOS while keeping the HYDRAIN program resident in memory. The option satisfies the requirement that sometimes the need arises to temporarily go to DOS, possibly to use a word processor or a spreadsheet. Select the **DOS Shell** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**D**> key. The user will be placed into DOS with the screen resembling that seen below in figure 19.

The IBM Personal Computer DOS
Version 3.10 (C)Copyright International Business Machines Corp 1981, 1985
 (C)Copyright Microsoft Corp 1981, 1985

Type EXIT to return to program.
C:\HYDRAIN>

Figure 19. DOS prompt.

Exit pulldown option

After completing all editing and saving all files, leave the HYDRAIN editor by using the **Exit** option. If file contents have changed but have not been saved, a warning screen will appear when leaving the editor. Proceeding with the exit option loses these changes. Canceling the exit allows use of the **Save** or **Save as** options (as appropriate) to preserve the changes. Select the **Exit** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**X**> key.

Edit Menu Category

The editor uses **Edit** pulldown menu options to **Mark** (block) and **Unmark** sections of data. The remaining **Edit** pulldown options act upon the marked information. These editing options include the ability to **Cut**, **Copy**, **Paste**, **Clear**, and **Delete** the marked (blocked) sections or window area. Figure 20 depicts the menu options in the **Edit** category. The editing options will not work unless marking has occurred sometime earlier in the editor session. Marked sections copied into memory allow repeated use of the paste option. This is useful for repeating similar sections of the command string. The cursor keys control the extent of the marked area. The editor can mark the entire contents of a window. Use the **Edit** pulldown menu options to copy data from one file to another. (The editor allows copied sections to transfer from one window to another. This is useful if using output from one program as input of another.) Select the **Edit** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**E**> key.

```
   File      Edit        Search      View       Help
            +)))))))))),
JOB*Sample* Mark      *
SWI*1     * Cut       *
HGL*1     * Copy      *
NEW*Link O* Paste     *
rem*Add fl* Unmark    *stem one ....
FLO*0.51  * Clear     *
PDA*0.024 * Delete    *.001
rem*Assume.)))))))))-ground elevations are 620.00 feet
PIP*10 620 620 601.45 601.35 -15
PNC*1 2 3 90 0 0
FLO*1.02
PDA*0.024 12 10 0 0 .001
PIP*123.18 620 620 601.35 600.49 -15
PNC*2 4 3 90 0 0
HOL*1
NEW*Link Two ...
FLO*33.91
PDA*0.013 12 10 0 0 .001
PIP*63.75 620 620 599.0 598.74 -36
PNC*3 4 3 180 0 0
REC*1
Help: Perform editing (mark, cut, copy, paste, clear & delete) operations.
File: C:\HYDRA\SAMPLE.HDA                            Alt=Edit  F1=Help
```

Figure 20. Edit menu category options.

Mark pulldown option

The **Mark** pulldown option blocks sections of data in the active window. The initial cursor position (cursor location before the start of the mark process) becomes one corner of the marked area. Moving the cursor about the window (with the cursor keys) sets the opposite corner of a rectangular section. The marked area is inside the rectangle. Marking rows to copy and paste begins by positioning the cursor at column one of the first row to copy. Turn on the **Mark** option and move down to the last row to copy. Mark the entire set of rows by moving to the last column (use the <End> key). The marked section is ready for cut, copy, and pasting operations. Moving to the last column is important in this type of operation. The editor distinguishes between marking an entire row and marking only a portion of a row. The **Mark** option uses the cursor color scheme to distinguish it from the regular text window. Select the **Mark** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**M**> key. A third method is to concurrently press the <**Ctrl**> and <**B**> keys <Ctrl+B> or <Alt+B> to select this option. The third method works from anywhere within the editor.

Cut pulldown option

The **Cut** pulldown option removes marked (blocked) sections from the input window. The cut section remains in memory. The **Paste** option inserts the section back into the input window. Use the **Cut** option for rearranging an input file layout. An alternative use is to delete a section of data. (Since the "deleted" section remains in memory, this action is not as final as using the **Delete** option.) Since it only operates in the input window, it is not as versatile as the **Copy** option. (The editor does not allow editing to occur to the output or help files.) The **Cut** option becomes inaccessible in these cases. Select the **Cut** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**T**> key from within the pulldown menu.

Copy pulldown option

The **Copy** pulldown option copies marked (blocked) sections from the active window. The copied section remains on the window and in memory. The **Paste** option inserts the section at a different active window location. The **Copy** option is useful for duplicating sections of input data. The **Copy** option also allows transfer of the copied section from the output window to the input window. (The editor does not allow editing to occur to the output or help files.) Marking rows to copy and paste begins by positioning the cursor at column one of the first row to copy. Turn on the **Mark** option and move down to the last row to copy. Mark the entire set of rows by moving to the last column (use the <End> key). The marked section is ready for cut, copy, and pasting operations. Moving to the last column is important in this type of operation. The editor distinguishes between marking an entire row and marking only a portion of a row. Select the **Copy** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**C**> key from within the pulldown menu.

Paste pulldown option

The **Paste** pulldown option inserts marked (blocked) sections into the input window. (The **Cut** or **Copy** options placed the marked sections into memory for the **Paste** option to access.) The insertion takes place immediately after the current cursor position. The **Paste** option will not overwrite existing data (it may move them around). Perform multiple insertions by repeated use of the **Paste** option. The **Paste** option is only active within the input window. The editor does not allow insertion to occur to the output or help files. Pasting entire rows involves properly marking and copying (or cutting) the desired rows. After completing this operation, move the cursor to the first column of the row immediately preceding the insertion point. Selecting the **Paste** option will place the rows between the cursor and the remaining data. Locating the cursor at the first column is important when pasting rows. The editor distinguishes between an entire row and only a portion of a row. Select the **Paste** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**P**> key from within the pulldown menu.

Unmark pulldown option

The **Unmark** pulldown option turns off the mark (block) option. Any marked section remain in memory for ensuing paste operations. Select the **Unmark** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**U**> key. A third method is concurrently pressing the <**Ctrl**> and <**U**> keys <Ctrl+U> or <Alt+U> to select this option. The third method works from anywhere within the editor.

Clear pulldown option

The **Clear** pulldown option erases marked (blocked) sections from the input window. The erased section retains spaces. The **Clear** option is useful to remove or clean-up input data. The **Clear** option is final -- no undo feature exists in the editor. The editor does not allow editing to occur to the output or help files. The **Clear** option becomes inaccessible in these cases. Select the **Clear** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**E**> key from within the pulldown menu.

Delete pulldown option

The **Delete** pulldown option removes marked (blocked) sections from the input window. The **Delete** option is useful to remove rows from the input window. The **Delete** option is final -- no undo feature exists in the editor. The editor does not allow editing to occur to the output or help files. The **Delete** option becomes inaccessible in these cases. The difference between **Delete** and **Clear** is important. **Clear** overwrites the data with spaces. **Deletes** removes the marked section. Select the **Delete** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**D**> key from within the pulldown menu.

<u>Search Menu Category</u>

The editor uses **Search** pulldown menu options to find the location of specific data within an active window. One of the options alters data involved in the search. The **Find** and **Repeat Find** options are available in all editor windows (input, output, and help). The **Change** option is only active within the input window. (The editor does not allow editing to occur to the output or help files.) Figure 21 depicts the menu options in the **Search** category. The range of **Search** options extends downward from the current cursor position. To globally locate data, use the cursor keys to move to the top of the file before beginning the **Search** operations. Select the **Search** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**S**> key.

```
    File        Edit        Search        View        Help
                          +))))))))))))))),
JOB*Sample Problem  * Find...          *
SWI*1               * Repeat Find      *
HGL*1               * Change...        *
NEW*Link One ...    .))))))))))))))))-
rem*Add flow into system one ....
FLO*0.51
PDA*0.024 12 10 0 0 .001
rem*Assume that all ground elevations are 620.00 feet
PIP*10 620 620 601.45 601.35 -15
PNC*1 2 3 90 0 0
FLO*1.02
PDA*0.024 12 10 0 0 .001
PIP*123.18 620 620 601.35 600.49 -15
PNC*2 4 3 90 0 0
HOL*1
NEW*Link Two ...
FLO*33.91
PDA*0.013 12 10 0 0 .001
PIP*63.75 620 620 599.0 598.74 -36
PNC*3 4 3 180 0 0
REC*1
Help: Search for specific data within the active window.
File: C\HYDRA\SAMPLE.HDA                        Alt=Edit  F1=Help
```

Figure 21. Search menu category options.

Find pulldown option

The **Find** pulldown option locates the occurrence of a character pattern (or string) in the active window. A dialog window prompts for the exact characters to use in the search. Upon finding the pattern, the editor moves the cursor to that location. To locate multiple occurrences of a string, use the **Find** option to initially define the characters. After locating the first occurrence, use the **Repeat** option to locate succeeding strings. The range of the **Find** option extends downward from the current cursor position. To globally locate data, use the cursor keys to move to the top of the file before starting the **Find** operation. Select the **Find** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**F**> key from within the pulldown menu.

Repeat pulldown option

After spotting the first occurrence of a pattern with the **Find** option, use the **Repeat** option to locate ensuing strings. The **Repeat** option is not available after performing one search. The **Repeat** option range extends downward from the current cursor position. Use the **Repeat** option (like the **Find** option) in any active window.   Select the **Repeat** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**R**> key from within the pulldown menu.

Change pulldown option

The **Change** pulldown option allow the editor to perform search and replace operations within the input window. A dialog window prompts for both the search and replace characters. Upon encountering the pattern, the editor moves the cursor to that location. Inquiries prompt whether the editor should replace the pattern in this particular instance. This prevents accidental data changes. The range of the **Change** option extends downward from the current cursor position. To globally locate data, use the cursor keys to move to the top of the file before initiating the **Change** operation. The **Change** option is only active within the input window. (The editor does not allow editing to occur to the output or help files.) Select the **Change** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**C**> key from within the pulldown menu.

View Menu Category

The editor designates windows to contain either input data, output (file) data, or help data. Up to two windows may be visible in the editor at one time. The editor always appoints one window as the active window. (The active window is always the window in which the cursor is present.) Use **View** pulldown menu options to change from the input to output windows. The menu also changes the active window to full-screen mode. The **View** menu offers an alternative to using the function keys <F2>, <F3>, <F4>, and <F5>. The **Input** (F2) option always returns the active window to the input file. The **Output** (F3) option displays the last output or file read in the window. The **Output** options can browse any text file (not just output). The **Full** option (F5) changes the windows from split-screen to full-screen mode. This option is useful when desiring to concentrate on a complete screen of data. The **Switch** option (F4) moves between any two presently displayed windows. Figure 22 depicts the menu options in the **View** category. (Note that the **View** option does not provide a means to access long help. The **Help** menu option contains the means to select the **Extended Help** option.) Select the **View** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**V**> key.

```
   File        Edit        Search        View        Help
                                       +)))))))))),
JOB*Sample Problem                     * Input    *
SWI*1                                  * Output   *
HGL*1                                  /)))))))))1
NEW*Link One ...                       * Full     *
rem*Add flow into system one ...* Switch  *
FLO*0.51                               .))))))))))-
PDA*0.024 12 10 0 0 .001
rem*Assume that all ground elevations are 620.00 feet
PIP*10 620 620 601.45 601.35 -15
PNC*1 2 3 90 0 0
FLO*1.02
PDA*0.024 12 10 0 0 .001
PIP*123.18 620 620 601.35 600.49 -15
PNC*2 4 3 90 0 0
HOL*1
NEW*Link Two ...
FLO*33.91
PDA*0.013 12 10 0 0 .001
PIP*63.75 620 620 599.0 598.74 -36
PNC*3 4 3 180 0 0
REC*1
Help: Change active window between input/output; or return to full-screen mode.
File: HYDRA\SAMPLE.HDA                              Alt=Edit  F1=Help
```

Figure 22. View menu category options.

Input pulldown option

The **Input** option always returns the active window to the input file. The editor calls the window that displays the input data file as the **input window.** The input window consists of two fields. The first field in the input window contains commands. The second field is for parameters associated with commands. The width of the two fields equals up to 80 characters. The input file is the only window in which editing operations can occur. Select the **Input** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**I**> key within the pulldown menu. A third method is pressing the <F2> function key. The third method works from anywhere within the editor.

Output pulldown option

The **Output** option returns the active window to the output or a user selected file. The editor calls the window that displays data files as the *output window* or *file browser*. Each row in the output window has a single field that holds data up to 127 characters wide. The **Open** pulldown option (under the **File** menu) can retrieve external text files. To take full advantage of the editor, place the data into the output window. Note that the input window is the only window in which editing operations can occur. If no output files yet exist, the default output window displays a temporary file (**UNTITLED.LST**). Select the **Output** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**O**> key within the pulldown menu. A third method is pressing the <F3> function key. The third method works from anywhere within the editor.

Full pulldown option

The **Full** option returns the active window to full-screen mode. When in split-screen mode, each window is 10 lines high. The full-screen window is 21 lines high. The extra 11 lines offers makes it easier to concentrate on the window contents (the split-screen can be distracting). When selecting the full-screen window, the other (nonactive) windows do not lose their contents. The editor considers these nonactive windows as hidden. Select the **Full** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**F**> key within the pulldown menu. A third method is pressing the <F5> function key. The third method works from anywhere within the editor.

Switch pulldown option

The **Switch** option moves control between windows. The option only affects the windows currently displayed in split-screen mode. The **Switch** option is an alternative to using the <F1>, <F2>, and <F3> keys. It is less flexible than these other methods. Select the **Switch** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**S**> key within the pulldown menu. A third method is pressing the <F4> function key.

Help Menu Category

The **Help** menu pulldown options provide a variety of options used to learn more about the editor. Use the **Extended Help** option to change to the long help window. This option offers an alternative to using the <F1> function key. The **Extended Help** option switches the active window to display help associated with the command currently in the input window. The **Command Index** option displays a listing of commands used by the active engineering program. Moving through the command matrix displays corresponding command short helps. Upon selecting a particular command, the editor displays corresponding extended help (long help). The **About** option provides basic information on the editor. Figure 23 depicts the menu options in the **Help** category. Select the **Help** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**H**> key.

Extended Help pulldown option

The **Extended Help** option displays long help for commands in the input window. Specifically, the help keys on the particular command associated with the input window cursor position. (The input window is the only window in which editing operations occur.) Select the **Extended Help** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**E**> key within the pulldown menu. A third method is pressing the <F1> function key. The third method works only within the input window. Otherwise, pressing <F1> activates context sensitive long help for menus or dialogs.

```
    File      Edit       Search      View        Help
                                              +)))))))))))))))),
JOB*Sample Problem                            * Command Index    *
SWI*1                                         * Extended Help... *
HGL*1                                         * About...         *
NEW*Link One ...                              .)))))))))))))))))-
rem*Add flow into system one ....
FLO*0.51
PDA*0.024 12 10 0 0 .001
rem*Assume that all ground elevations are 620.00 feet
PIP*10 620 620 601.45 601.35 -15
PNC*1 2 3 90 0 0
FLO*1.02
PDA*0.024 12 10 0 0 .001
PIP*123.18 620 620 601.35 600.49 -15
PNC*2 4 3 90 0 0
HOL*1
NEW*Link Two ...
FLO*33.91
PDA*0.013 12 10 0 0 .001
PIP*63.75 620 620 599.0 598.74 -36
PNC*3 4 3 180 0 0
REC*1
Help: Provides help on editor commands and operation.
File: C:\HYDRA\SAMPLE.HDA                          Alt=Edit  F1=Help
```

Figure 23. Help menu category options.

Command Index pulldown option

        The **Command Index** option displays the complete list of commands associated for an engineering program. Moving through the command matrix with the cursor keys displays corresponding command short help at the screen bottom. After pressing <Enter>, the long help window becomes active for the selected command. Use this option to help to remember a specific command name or command action.

        If the extended help window is present on the screen when moving through the command index, the long help text automatically changes to reflect the highlighted command. This is a quick way to review the first 10 lines of the commands to glean purpose and structure information. Select the **Command Index** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**C**> key within the pulldown menu.

About pulldown option

        The HYDRAIN editor assists in the creation and editing of command line input data sets. The editor program uses common user access (CUA) interfaces and standards whenever possible. In this manner, the editor is similar to commercially available text editors and word processors. The editor uses three windows to hold input, output, and help information. Context sensitive helps exists for all menu options and commands.

Dialog Windows

       The editor uses dialog windows to receive information on files, paths, extensions, and character strings (for search and replace). Figure 24 depicts a dialog window used by the **Open** menu option. There is a series of fields within each dialog window. To move within a field (for example, moving through the list of files), use the arrow keys. To move between fields, use the <Tab> keys.

```
JOB│Sample Problem
SWI│1                           ┌─────Open File──────────────────────────────
HGL│1                           │
NEW│L            ┌─────────────File Name────────────────────────────┐
rem│A            │  *.HDA                                            │
FLO│0            │                                                   │
PDA│0            └───────────────────────────────────────────────────┘
rem│A     Directory:   C\HYDRA\
PIP│1
PNC│1                                                  ┌─ Dirs/Drives ─┐
FLO│1     ┌─────────────────────────────────────┐     │  ..           │
PDA│0     │  EX1.HDA      EX2.HDA      EX3.HDA   │     │  [-A-]        │
PIP│1     │  EX4.HDA      EX5.HDA      EX6.HDA   │     │  [-B-]        │
PNC│2     │  EX7.HDA      ROUTE95.HDA  OAKLND.HDA│     │  [-C-]        │
HOL│1     │  SAMPLE.HDA                          │     │  [-D-]        │
NEW│L     │                                     │     └───────────────┘
FLO│3     └─────────────────────────────────────┘
PDA│0     < Ok >                   < Cancel >              < Help >
PIP│6
PNC│3 4 3 180  0  0
REC│1
```

Help: First command in input dataset.
Enter=Execute   **Esc**=Cancel   **Tab**=Next Field   **Arrow**=Next Item

APPENDIX B: HYDRAIN DIRECTORY STRUCTURE

The standard HYDRAIN disk and directory layout places a series of directories on a single hard disk drive. With the exception of the Intermediate/Shared files path, this arrangement ensures that every program or file is one level from the root directory. The directory names reflect the contents therein. For example, in the default layout, the HYDRA directory contains the executable, input, output, and help files associated with the HYDRA storm drain program.

This organization is advantageous if the user decides to run the engineering programs in batch mode. Additionally, by placing the entire HYDRAIN system on a single hard disk, the installation program can check that disk for sufficient space BEFORE copying the HYDRAIN files. (This prevents a partial installation from occurring).

However, for the HYDRAIN program, there is more than a single path required for each of the programs. In reality, each of the programs (HYDRAIN, HYDRA, WSPRO, HYDRO, HY8, HYCHL, and NFF) has at least two, and, in the case of HY8, possibly up to 11 distinct directories! For example, the five batch engineering programs have **separate** directories for input, output, executable, and help files. The standard (or default) layout simplifies things by using the same directory "name" for all the elements used in a particular program. This results in the simplified directory structure, depicted earlier in figure 2.

Overriding this standard configuration is most easily implemented by defining the layout and using a text editor to edit the contents of the **HYDRAIN.CNF** and **HY8.CNF** files. (These files are created at installation and are used by the HYDRAIN application programs and HY8, respectively.) After the desired layout has been placed in these files, use the DOS Copy command to redistribute the files. Since this will also involve potentially copying many files all over the system, this should be attempted only by experienced DOS users.

The easiest reconfiguration would be to select a single directory, say HYDRAIN, and copy all of the other directories to this directory. The only potential duplicate names are output files having the LST extension. The remainder of the HYDRAIN files have been named to prevent potential overwrites.

HYDRAIN executables are DOS batch programs. As such, command lines passed to them may not exceed 128 characters, a limitation of DOS. The default layout guarantees acceptable command lines. Should you NOT use the default or standard layout, the system will sometimes produce unpredictable results.

APPENDIX C: BATCH EXECUTION OF HYDRAIN

INTRODUCTION

The engineering programs that comprise the HYDRAIN system can be accessed in three methods: from the HYDRAIN program, from HYEDT, or from running them in DOS, without any application programs. The following material discusses how to proceed with the HYDRAIN programs using the third method.

ENGINEERING PROGRAMS

There are seven engineering programs currently in the HYDRAIN system: HYDRA, WSPRO, HYDRO, HY8, HYCHL, NFF and HYEQT. All programs (with the exception of HY8) consist of a single executable file. HY8 consists of several executable files. The five programs are seen below:

Engineering Program	Program Description
HYDRA.EXE	HYDRA executable program
WSPRO.EXE	WSPRO executable program
HYDRO.EXE	
HYDRO executable program	
HYCHL.EXE	HYCHL executable program
HY8.EXE	HY8 executable linker
NFF.EXE	NFF executable program
HYEQT.EXE	HYEQT executable program

HYDRA, WSPRO, HYDRO, HY8, and HYCHL are known as BATCH programs (this is not to be confused with a DOS Batch file). This means that they assume that any data they use to solve a problem already exists and is in a separate input data file. After program execution, the results calculated by the program are placed in a separate output file. This approach is similar to how mainframe programs process information.

HY8 is also (and primarily) an INTERACTIVE program. That is, it combines data entry and program execution together. For example, HY8 will collect data, calculate intermediate output, collect more data and calculate more information, and so on until the problem has been completed. The user is an element of the process.

GENERATING INPUT FILES

Before running a program under DOS, an input file must be created. The versions of HYDRA, WSPRO, HYDRO, and HYCHL provided in the HYDRAIN system need command line input files with the definitions given in the documentation or appropriate HELP files. These formats must be adhered to if the input file is created with a word processor or a text editor. If the file is created with the HYEDT, the format is predetermined.

RUNNING HYDRAIN PROGRAMS

HYDRA -   To run HYDRA from DOS, at the prompt type "HYDRA" and strike
           <Enter>. Several blank lines will scroll across the screen. A message
           prompting the user for the required information will appear. When it does,
           enter the requested information. For example:

                    C>HYDRA<Enter>

                    - spaces -

                    Enter the name of the data file: ROUTE1.HDA<Enter>
                    Enter the name of the output file: ROUTE1.LST<Enter>
                    Enter the name of the drive and path
                    containing intermediate files - Press
                    <Enter> key if none or to use default
                    drive and path:<Enter>
                    Enter units, 0 (SI) or 1 (English): <Enter>

           An alternative is to type the executable file, input data file, output file and
           intermediate drive on the same line. This causes the program to function in
           the same manner as above, but without prompting the user for the files.

                    C>HYDRA ROUTE1.HDA ROUTE1.LST C:\ 0<Enter>

WSPRO   -   To run WSPRO from DOS, at the prompt type "WSPRO" and
              strike <Enter>. Similar to HYDRA, a message prompting the user
              for the input data file will appear. When it does, enter the
              requested information. For example:

                    C>WSPRO<Enter>
                    Enter the name of the data file: ROUTE1.WSP<Enter>
                    Enter the name of the output file: ROUTE1.LST<Enter>

An alternative is to type the executable file, input data file, and output file on the same line. This causes the program to function in the same manner, but without prompting the user for the files.

C>WSPRO ROUTE1.WSP ROUTE1.LST<Enter>

HYDRO   -   To run HYDRO from DOS, at the prompt type "HYDRO" and strike <Enter>. A message prompting the user for the input data file will appear. When it does, enter the requested information. For example:

C>HYDRO<Enter>
Enter the name of the data file: ROUTE1.HDO<Enter>
Enter the name of the output file: ROUTE1.LST<Enter>
Enter the name of the drive and path
containing intermediate files - Press
<Enter> key if none or to use default
drive and path:<Enter>

An alternative is to type the executable file and the input data file on the same line. This causes the program to function in the same manner, but without prompting the user for the data file.

C>HYDRO ROUTE1.HDO ROUTE1.LST C:\ 0<Enter>

HYCHL   -   To run HYCHL from DOS, at the prompt type "HYCHL" and strike <Enter>. A message prompting the user for the input data file will appear. When it does, enter the requested information. For example:

C>HYCHL<Enter>
Enter the name of the data file: ROUTE1.CHL<Enter>
Enter the name of the output file: ROUTE1.LST<Enter>
Enter the name of the drive and path
containing intermediate files - Press
<Enter> key if none or to use default
drive and path:<Enter>

An alternative is to type the executable file, input data file and output file. This causes the program to function in the same manner, but without prompting the user for the files.

C>HYCHL ROUTE1.CHL ROUTE1.LST<Enter>

HY8   -   To run HY8 from DOS, at the prompt type "HY8" and strike <Enter>. Since HY8 is Interactive, the user will be prompted for subsequent actions

by the program itself. It is a good idea to put the directory containing HY8 in the PATH found in the AUTOEXEC.BAT file.

APPENDIX D: NATIONAL FLOOD FREQUENCY PROGRAM

The United States Geological Survey (USGS), in cooperation with the Federal Highway Administration and the Federal Emergency Management Agency, has compiled all the **current** statewide and metropolitanwide regression equations into a microcomputer program entitled the National Flood Frequency (NFF) program. NFF summarizes techniques for estimating flood-peak discharges and associated flood hydrographs for a given recurrence interval or exceedance probability for unregulated rural and urban watersheds. These estimates should be useful to engineers and hydrologists for planning and design applications. NFF includes the statewide regression equations for rural watersheds in each State, includes the applicable metropolitanwide or Statewide regression equations for urban watersheds, and generates rural and urban frequency functions and hydrographs. The hydrographs are also written to the ITM directory as XXXXXXXX.QT files for use of other HYDRAIN programs.

More detailed NFF documentation is available from: Jennings, M.E., et al., Nationwide Summary of U.S. Geological Survey Regional Regression Equations for Estimating Magnitude and Frequency of Floods at Ungaged Sites, 1993, Water-Resources Investigations Report 94-4002, USGS, Reston, VA, 1994. The NFF is accessed through the HYDRAIN applications program and the user is prompted by the interactive program to provide appropriate input data. The version of the NFF program included in HYDRAIN 6.0 is substantially unchanged from that discussed in this report. The only change is the additional capability to perform calculations using SI units. Regardless of units selected by the user, NFF performs calculations using English units. In order to maintain consistency with existing units and the USGS Report, this discussion uses the English units involved. When SI units are selected, the program prompts the user for the appropriate SI values and reports output in SI units.

The rural regression equations in NFF are based on watershed and climatic characteristics that can be obtained from topographic maps or rainfall reports and atlases. The most frequently used watershed and climatic characteristics are drainage area, main-channel slope, and mean annual precipitation. The regression equations are generally reported in a multiplicative form where **a** is the multiplicative constant and **b, c, d**, etc., are exponents. The usual variations are where RQ_T is the T-yr rural flood-peak discharge, **A** is the drainage area, **S** is the channel slope, **P** is the mean annual precipitation, and **a**, **b**, **c**, and **d** are regression coefficients.

Seven-parameter urban equations are based on multiple regression analysis of urban flood frequency data from 199 urbanized basins. The variables are:

- **Q2**, **UQ5**, . . . **UQ500** are the urban peak discharges, in cubic feet per second, for the 2-, 5-, . . . 500-yr recurrence intervals.

• **A** is the contributing drainage area, in square miles, as determined from the best available topographic maps; in urban areas, drainage systems sometimes cross topographic divides. Such drainage changes should be accounted for when computing **a**.

• **SL** is the main channel slope, in feet per mile, measured between points which are 10 percent and 85 percent of the main channel length upstream from the study site (for sites where **SL** is greater than 70 ft/mi, 70 ft/mi is used in the equations.

• **RI2** is the rainfall, in inches, for the 2-h, 2-yr occurrence, determined from U.S. Weather Bureau (USWB) Technical Paper 40 (1961) (eastern USA), or from the National Oceanic and Atmospheric Administration (NOAA) Atlas 2 (Miller and others, 1973) (western USA); HYDRO can be used to estimate this value.

• **ST** is basin storage, the percentage of the drainage basin occupied by lakes, reservoirs, swamps, and wetlands; in-channel storage of a temporary nature, resulting from detention ponds or roadway embankments, should not be included in the computation of **ST**.

• **BDF** is the basin development factor, an index of the prevalence of the urban drainage improvement.

• **IA** is the percentage of the drainage basin occupied by impervious surfaces, such as houses, buildings, streets, and parking lots.

• **RQT** are the peak discharges, in cubic feet per second, for an equivalent rural drainage basin in the same hydrologic area as the urban basin, for a recurrence interval of **T** years; equivalent rural peak discharges are computed from the rural equations for the appropriate State, in the NFF program, and are automatically transferred to the urban computations.

The basin development factor (**BDF**) is a highly significant parameter in the equations, and provides a measure of the efficiency of the drainage basin. It can be determined from drainage maps and field inspections of the drainage basin. The basin is first divided into upper, middle, and lower thirds on a drainage map. Each third should contain approximately one-third of the contributing drainage area, and stream lengths of two or more streams should be approximately the same in each third. Within each third of the basin, four characteristics of the drainage system must be evaluated and assigned a code of 0 or 1. Summation of the 12 codes (four codes in each third of the basin) yields the **BDF**. Within each third, the codes are estimated as follows:

1. *Channel improvements*. If channel improvements such as straightening, enlarging, deepening, and clearing are prevalent for the main drainage channels and principal tributaries (those that drain directly into the main channel), then a code of 1 is assigned. To be considered prevalent, at least 50 percent of the main drainage channels and principal tributaries must be improved to some degree over natural

conditions. If channel improvements are not prevalent, then a code of zero is assigned.

2. *Channel linings*. If more than 50 percent of the length of the main channels and principal tributaries has been lined with an impervious surface, such as concrete, then a code of 1 is assigned to this characteristic. Otherwise, a code of zero is assigned. The presence of channel linings would obviously indicate the presence of channel improvements as well. Therefore, this is an added factor and indicates a more highly developed drainage system.

3. *Storm drains or storm sewers*. Storm drains are defined as those enclosed drainage structures (usually pipes), frequently used on the secondary tributaries where the drainage is received directly from streets or parking lots. Many of these drains empty into open channels; however, in some basins they empty into channels enclosed as box and pipe culverts. When more than 50 percent of the secondary tributaries within a subarea (third) consists of storm drains, then a code of 1 is assigned to this aspect, otherwise a code of zero is assigned.

4. *Curb-and-gutter streets*. If more than 50 percent of the subarea (third) is urbanized (covered with residential, commercial, and/or industrial development), and if more than 50 percent of the streets and highways in the subarea are constructed with curbs and gutters, then a code of 1 would be assigned to this aspect. Otherwise, a code of zero is assigned. Drainage from curb-and-gutter streets frequently empties into storm drains.

The procedure used in NFF to compute the average hydrograph is known as the dimensionless hydrograph method. There are three essential parts to the dimensionless hydrograph method: (1) the peak discharge for which a hydrograph is desired, (2) the basin lagtime, and (3) the dimensionless hydrograph ordinates. In order to compute the average, or design hydrograph using the NFF procedures, the user selects the peak discharge from the NFF frequency output. The user must also provide an estimate of the basin lagtime. The NFF program then computes the hydrograph using the dimensionless ordinates of the hydrograph which are stored in the NFF program.

A procedure is included in the NFF program for extrapolating the regional regression equations in any State to the 500-yr flood. The extrapolation procedure consists of fitting a Log Pearson Type III curve to the 2- to 100-yr flood discharges given by NFF and extrapolating this curve to the 500-yr flood discharge.

NFF methods are applicable and representative of data used to derive them. The user of NFF is responsible for the assessment and interpretation of the computed frequency results, the following limitations of NFF should be observed:

1. The rural equations in NFF should only be used for rural areas and should not be used in urban areas unless the effects of urbanization are insignificant.

2.   NFF should not be used where dams, flood-detention structures, and other man-made works have a significant effect on peak discharges.

3.   The user is cautioned that the magnitude of the standard errors may be larger than the reported errors if the equations in NFF are used to estimate flood magnitudes for streams with variables outside the ranges for the necessary variables as identified in NFF.

4.   Drainage area must always be determined, as NFF requires a value. Although a hydrologic region may not include drainage area as a variable in its prediction equation in order to compute a frequency curve, NFF requires the use of a watershed's drainage area for other computations.

5.   Frequency curves for watersheds contained in more than one region cannot be computed if the regions involved do not have corresponding T-yr equations. Failure to observe this limitation of NFF will lead to erroneous results. Frequency curves are weighted by the percentage of drainage area in each region. No provision is provided for weighting frequency curves for watersheds in two different States.

6.   In some instances, the maximum flood envelope value may be less than some T-yr computed peak discharges for a given watershed. The user should carefully determine which maximum flood-region contains the watershed being analyzed.

7.   NFF allows the weighting of estimated and observed peak discharges for frequency curve calculations. However, since very few 500-yr peak discharge estimates have been published, NFF does not allow the user to enter observed values for the 500-yr peak discharge. The user should evaluate the weighted curve thoroughly; it is possible for the 500-yr peak discharges to be less than some of the other less extreme T-yr peak discharges.

8.   The user should be cautioned that some hydrologic regions do not have prediction equations for peak discharges as large as the 100-yr peak discharge. The user is responsible for the assessment and interpretation of any interpolated or any extrapolated T-peak discharges. Examination of plots of the frequency curves computed by NFF is strongly recommended.

9.   Flood hydrographs, computed by procedures in NFF, are not applicable to watersheds whose flood hydrographs are typically from snowmelt runoff, or watersheds that typically experience double-peaked hydrographs. Furthermore, the flood hydrograph estimation procedures may not be applicable to watersheds in the semi-arid/arid regions of the Nation.

APPENDIX E: THE HYDRAIN EQUATION PROGRAM

The HYDRAIN equation program (HYEQT) is an application program that allows the user to create and solve regression equations for solving peak flow (or any other formula of interest). The NFF program already contains many USGS peak flow regression equations within its data base. The HYEQT program allows the user to supplement and modify these or other equations to reflect their specific needs. HYEQT uses the entire display screen and possesses advanced data manipulation abilities.

USING THE HYEQT PROGRAM

The HYEQT program is assessed from the HYDRAIN program, under the Analyze pull-down menu. Upon entering HYEQT, the initial screen displays either a series of blank fields, or the last series of equations solved.

The program groups a series of equations into an element designated a **Region**. A **Region** may consist of a watershed, hydrologic district, or some other unique division in a State. Each region can contain up to ten regression equations with a total of fifteen independent variables. All Regions are placed into a single ASCII data base file. There is no practical limit to the number of Regions that the program can access (the upper limit is a function of the available disk space).

The program uses cursor keys to move or scroll the data. The keys and their respective actions are:

· **Arrows** - move cursor up, down, left, or right through a screen or field. The program will scroll, as needed, to display additional text or data within a field.

· **PgUp** - moves the cursor position up an entire screen of data (a screen is the quantity of data viewable in a window).

· **PgDn** - moves the cursor position down to the bottom of the screen.

· **Home** - moves cursor to the first column in the current row or field.

· **End** - moves cursor to the last column in the current row or field.

· **Tab** - moves cursor to next field or parameter.

EDIT AND SOLVE MODE SCREENS

The program uses two screen modes; **Edit** and **Solve**; to create or process the equations. The **Edit** mode places the user into a screen with four sets of fields. The set of fields in the upper left section of the screen is where the equations can be entered or modified. (There are 10 rows in this section.) The equation format should contain dependent and independent variables, coefficients and appropriate arithmetic operators. The dependent variable and independent variables MUST be separated by an equal sign [=]. Valid arithmetic operators include: addition [+], subtraction [-], multiplication [*], division [/], and exponentials [**]. The program allows use of parentheses [(] and [)]) within the equation to group variables and coefficients. The program uses standard hierarchal operations for the application of these operators. An (imaginary) example of a valid equation is:

$$Q25 = 1.34 * Area ** 0.25 + Slope ** 0.112 / (Length - 10 ** Runoff)$$

Note that **Q25** is the dependent variable; **Area**, **Slope**, **Length**, and **Runoff** are the independent variables; and **1.34**, **0.25**, **0.112**, and **10** are coefficients. Spaces between the variables are not required, but aid in viewing and debugging.

The fields in the upper right section of the Edit mode screen contain areas for creating short helps for the dependent variables or the entire equation. (Once again, there are 10 rows or fields, each for the help of a possible formula.) The two fields in the bottom portion of the screen list the independent variables and short help associated with each of them.

The **Solve** mode screen shows the already-created equations in the top left section; the independent variables in the bottom portion; and the solutions in the top right screen section. The equations can not be modified within the Solve mode. The values for the independent variables can. After entering all values in the fields next to the independent variable, the program automatically "plugs" them into the equations and displays the solutions. The solution is dynamic. Changing any of the independent variable values instantly changes the solution. As the user moves from field to field, HYEQT displays the short helps (developed in the Edit mode) at the bottom of the screen.

MENUS AND DIALOGS

The editor uses a series of menus and dialog windows to provide additional options when creating or editing an equation. The editor has two menu categories: **Region** and **Edit**. Both have pulldown menus that provide specific options for the category.

The menu system is separate from the Edit and Solve screens. The editor toggles between these screens and menu systems. The <Alt> key provides this toggling capability. The menu system activates by pressing <Alt> from the Edit or Solve mode screens.

The menu system uses a subset of cursor keys to move and scroll through options. The keys and their respective actions are:

· **Arrows** - move cursor up, down, left, or right through the menus. In a pulldown menu, moving left or right automatically move to the next pulldown menu. (In other application programs, the cursor must first move to the top menu, over, and back down.) The menus are not ring menus. (This means that moving right at the **Edit** field does not circle back to the **File** field.)

· **Esc** - cancels menu or dialog operations, returning to the active window.

· **Enter** - selects and performs the current option (designated by the cursor).

· **H**ighlighted characters - select an operation or option. Striking the **h**ighlighted character is equivalent to moving to the option and pressing <Enter>.

Region Menu Category

The program uses the **Region** menu category options to create, retrieve, save, erase, & print regions; and to leave the editor. The options are: New, Open, Save, Save as, Delete, Print, and Exit. Use the **New** option to create a new region. The **Open** option retrieves an existing region to edit or view. The **Save** option will save the current working region (that is, the region in the input window) under the same name. To save a region under a different name (or for the first time after using the **New** option to create a working region), use the **Save as** option. Delete an old or erroneous region with the **Delete** option. The **Print** option sends contents of the current window to an output device. The final option, **Exit**, ends the HYEQT program. Select the **Region** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**R**> key.

New pulldown option

The **New** pulldown option clears the input window of any existing region and creates a blank, untitled screen in the Edit mode. The new region has the temporary name of **UNTITLED**. The newly created region is available to develop a set of equations. Use the **Save as** option to preserve the region. Select the **New** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**N**> key.

Open pulldown option

The **Open** pulldown option retrieves an existing region into the current window. When selecting this option, the next screen will be a dialog box showing regions in the data base file. After selecting a region from the catalog, the program replaces the existing region (located on the

screen) with this newly selected region. Select the **Open** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**O**> key.

Save pulldown option

The **Save** pulldown option writes the contents of the current screen to the active region. The program provides no opportunity to change the region name when using the **Save** option. (Use the **Save as** option to store the region under a different name.)   The **Save** option writes over the existing region, destroying the prior data. Select the **Save** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**S**> key.

Save as pulldown option

The **Save as** pulldown option writes the contents of the current screen to a region whose name the user creates or selects. When selecting this option, the next screen will be a dialog box showing all current regions. The program displays a field prompting for a region name. This field is where an alternative name is entered. Select the **Save as** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**V**> key.

Delete pulldown option

The **Delete** pulldown options deletes the contents of a region and removes it from the data base. Select the specific region using a dialog box of current regions. Select the **Delete** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**D**> key.

Print pulldown option

The **Print** pulldown options sends the contents of the screen to the printer. The program assumes that the output device port location is LPT1. Select the **Print** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**P**> key.

Exit pulldown option

After completing all editing and saving all files, leave HYEQT by using the **Exit** option. If region contents have changed but have not been saved, a warning screen will appear when leaving the program. Proceeding with the exit option loses these changes. Canceling the exit allows use of the **Save** or **Save as** options (as appropriate) to preserve the changes. Select the **Exit** option by moving to the option with cursor keys and pressing <Enter>. Another method is to press the highlighted <**X**> key.

<u>Edit Menu Category</u>

   The program uses the **Edit** menu category options to switch between the Edit and Solve screen modes. The options are: Solving Equation and Edit Equation. The actions of these options have been described earlier. Use the cursor keys and <Enter> to select a specific option, or press the highlighted letter.